ARS SPECIAL REPORT

Agricultural Writers' Manual on Infectious Animal Diseases

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Agricultural Research Service
UNITED STATES DEPARTMENT OF AGRICULTURE

FOREWORD

The huge and complicated livestock industry, which feeds millions of people and gives a livelihood to farmers, handlers, tradesmen, and others, is subject to constant danger from diseases having potential effects that range from slight debilitation and economic loss to decimation of flocks and herds. A number of these diseases may affect man.

This manual on infectious animal diseases has been prepared as a working tool for reporters and others whose responsibilities include public relations work with livestock and poultry raisers. Some of the diseases covered, such as rinderpest and foot-and-mouth, are not now present in the United States. But increasing worldwide travel and transportation make ever more difficult the job of keeping these and other foreign diseases out of the country. If one of them should gain entrance, the need for prompt action would be acute.

No individual acting alone can hope to meet all the problems of animal disease. Some diseases can be conquered only if everyone, including livestock owners and veterinarians, acts together, with Federal and State governments, to mobilize the full aid of science and put into effect such control and preventive measures as each situation demands.

Calm and accurate reporting of serious disease outbreaks and the measures being taken to combat them can go a long way toward allaying fear and panic among livestock owners, commercial interests, consumers, and others in the area affected. Reporters can in this way make a vital contribution to the success of a campaign.

Another job--more workaday but perhaps no less important--is the routine help that reporters can give livestock owners on diseases that are unspectacular in their effects. This job involves timely reminders to take appropriate measures to prevent or treat such diseases.

It is hoped that this manual will help to fill the need, so often expressed, for accurate information on at least some of the animal diseases that are a threat to the livestock industry.

B. T. Shaw

B. T. Shaw, Administrator

Agricultural Research Service

Agricultural Writers' Manual on Infectious Animal Diseases

Information in this manual was provided by the Animal Disease Eradication Branch, the Animal Disease and Parasite Research Branch, and the Animal Inspection and Quarantine Branch, Agricultural Research Service, with assistance by the U. S. Public Health Service, Department of Health, Education, and Welfare

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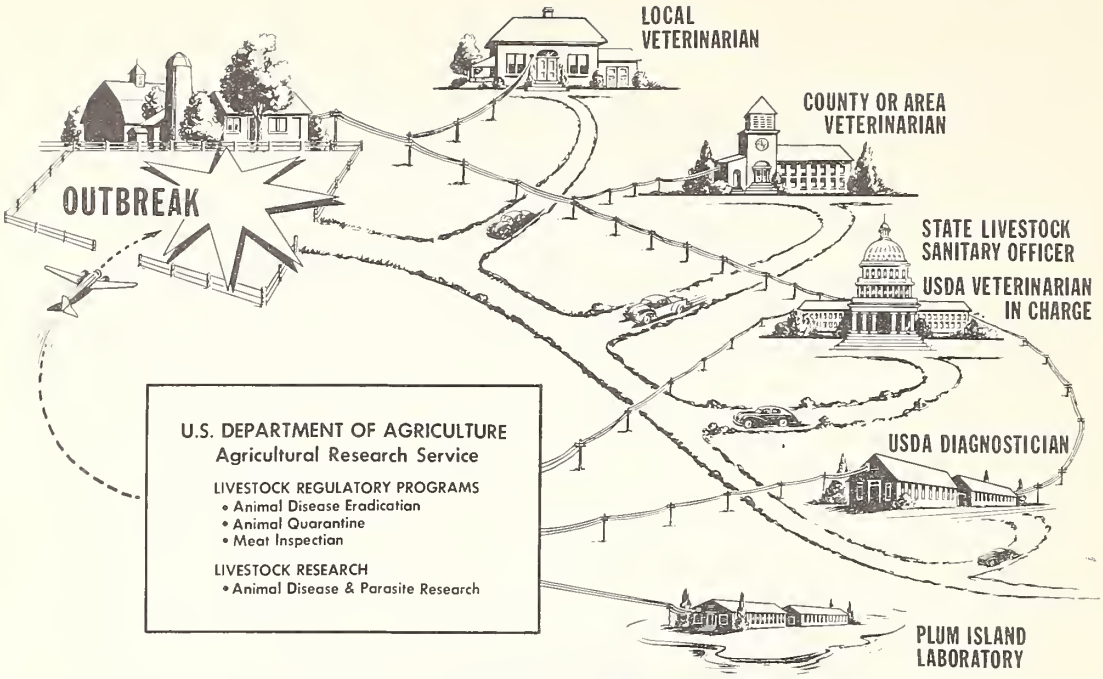
CONTROL AND ERADICATION



LINES OF COMMUNICATION AND ASSISTANCE IN OUTBREAKS OF ANIMAL DISEASES

The farmer or rancher is generally the first to detect disease among his animals. He normally calls in his practicing veterinarian. If the illness appears unusual or dangerous, the veterinarian reports to State and U.S. Department of Agriculture regulatory officials. If their findings warrant, they may impose a quarantine and call in a specially trained USDA veterinary diagnostician. Especially if it is one of the vesicular diseases--foot-and-mouth disease, vesicular stomatitis, or vesicular exanthema--the outbreak is reported to Washington and the necessary steps are taken for control and eradication. With permission of the USDA, tissue samples may be sent interstate to Federal laboratories for examination. If the disease proves to be a dangerous infection, State livestock sanitary authorities set up a quarantine and join with Federal officials in control and regulatory measures.

ANIMAL-DISEASE PROGRAMS IN THE UNITED STATES

Ideally, the goal of animal-disease programs in the United States would be the progressive eradication of all transmissible animal diseases, first from areas, then regions, and finally the Nation. Such an accomplishment would provide our growing population with sufficient animal proteins for good nourishment, and assure the livestock industry a secure position in our national economy.

A big step forward was taken in 1884, when the former Federal Bureau of Animal Industry was established to work with the States in eradicating contagious pleuropneumonia in cattle and other communicable livestock diseases. When the Congress was considering this legislation, individual States were trying in vain to stamp out pleuropneumonia. The doubters, dubbing the legislation the "horse-doctor bill," pointed to these failures. But the bill became law, the Bureau was organized, a program of Federal-State cooperation was begun, research was done on the disease, and in less than 10 years contagious pleuropneumonia was wiped out. It has not appeared since.

With the help of research and the cooperation of livestock owners, State and Federal officials went on to wipe out the deadly fever tick, scabies in cattle, dourine and glanders in horses, six invasions of foot-and-mouth disease, fowl plague, and outbreaks of the highly fatal form of Newcastle disease.

The system of Federal-State cooperation worked so well that it has been continued and developed until today it brings a workmanlike precision to the battle against animal diseases. Today, we are well on the way toward eradicating bovine tuberculosis, scabies in sheep, pullorum disease in poultry, and vesicular exanthema in hogs. Federal responsibility is carried out through the Agricultural Research Service.

From the standpoint of programs, animal diseases divide naturally into two main classes:

(1) Diseases we eradicate, and
(2) Diseases we control.

Diseases We Eradicate

Many elements enter into the choice of diseases to be eradicated. Much of the choice depends on the disease and what science has produced to combat or cure it. Diseases that cause large economic losses are more apt to be eradicated. In practice, no campaign of eradication can succeed without the support of livestock owners. Diseases are eradicated only when all concerned become convinced that they are easier and more economical to eradicate than to live with.

There is a fear in the public mind of foot-and-mouth disease, which is understandable because of its tremendous spreading power. Even when

the mortality is low, the disease has a serious debilitating effect on recovered livestock. It is better to slaughter affected and exposed animals before the disease becomes established than to live with an ailment that saps susceptible animals until they are uneconomic producers.

Vaccines for this disease are relatively ineffective, and the best way of dealing with it--used by all countries where it has not been allowed to become established--is the slaughter of diseased and exposed animals.

In Great Britain, where "stamping out" methods are used, the official view is summarized as follows in the Report of the Departmental Committee on Foot-and-Mouth Disease, 1952-1954:

> The disease would rapidly establish itself as endemic in any country that failed to take energetic and rigorous measures to prevent it. If it were to do so in this country the result would be a national calamity....
>
> In the circumstances of today, and of the immediate future so far as they are foreseeable, any idea that it would be possible to do away with stamping-out by making the whole susceptible animal population--or even all cattle--immune by vaccination is in the realm of fantasy.

Many animal diseases are communicable to human beings, and this often provides an incentive to eradicate them. This incentive has been helpful in the work done toward eradicating bovine tuberculosis and brucellosis (undulant fever in humans).

Eradication methods are more readily applied to some animal diseases than to others. For instance, piroplasmosis (tick fever in cattle) and scabies in sheep are eradicable by dipping, a practical method of removing the external parasites responsible for the trouble.

Diseases We Control

If an effective vaccine or treatment is found for a disease, there is a strong tendency to fall back from complete eradication to a position based on preventive measures.

Hog cholera, for instance, is a serious and usually fatal disease. It once killed annually 13 percent of the hogs in the United States. Vaccination has been used to greatly reduce the annual loss. Various control measures are exercised by both the States and the Federal Government to prevent the spread of this disease. But hog cholera continues to cause substantial losses.

Control measures--vaccination, testing, slaughter of reactors, and sanitation--reduced the incidence of brucellosis from about 7 percent in 1936 to 2.6 percent in 1955. The use of pasteurized milk has also reduced the hazard to humans of undulant fever, although a risk remains in handling brucellosis-infected animals and their products. Brucellosis is a costly disease to live with, and tools are available for stamping it out.

We live with some diseases because we do not have the know-how to eradicate them. For instance, there is a vaccine for anthrax, an infectious and usually fatal disease of cattle and sheep, which sometimes becomes a serious problem in other animals and is a dangerous disease when contracted by people. But, the causative organism lives for long periods in the soil, and although various steps are taken to control anthrax its eradication is not yet possible.

KEEPING DISEASE OUT OF THE UNITED STATES

In order to keep animal diseases out of the country it is necessary to know what diseases are likely to enter from a given country. Protective measures and entry requirements are tailored to fit the disease hazards posed by a given country, and may range from a complete embargo to a free flow of livestock. For example, no ruminants (cud-chewing animals) or swine are admitted from countries in which rinderpest or foot-and-mouth disease are known to exist. On the other hand, in neighboring countries such as Canada, where disease prevention, control, and eradication measures used are comparable to our own, free entry is the rule rather than the exception.

In most countries, a person desiring to import animals into the United States must first apply for a permit from the Agricultural Research Service, U.S. Department of Agriculture. This gives the Department an opportunity, before issuing the permit, to review the general disease situation in the country from which the import is to be made and to investigate the health of the animals to be shipped. Shipment is allowed only after the permit is received by the shipper. One reason for this forehandedness is the speed of shipment, for more and more animals are being transported by airplane. Other devices used to insure the health of imported animals include health certification by a veterinary official in the country of origin.

Routine inspections are made at points of entry by ARS veterinarians. Quarantine, testing, and other safeguards are used as required. Cooperating with ARS in this regulatory work is the Bureau of Customs, Department of the Treasury, which does not release any animal entering the United States until it is approved by ARS officials.

Similar precautions are taken with regard to a wide range of animal products, including hides, wool, hair, bristles, glue stock, bones, horns, hoofs, bone meal, blood meal tankage, intestines (used for sausage casings), glands and organs used in the making of pharmaceuticals, and so on, depending upon the disease situation in the country of origin. Such souvenirs as blood-stained banderillas, the barbed sticks used in bull-fighting, are refused entry from countries that have diseases transmissible by this means.

Steps are taken to avoid the entry of disease in hay and straw, because they may have been contaminated by diseased animals, or bags and wrappings used on fresh or frozen meats. Carriers such as boats and airplanes that transport animals or their products may have to be thoroughly cleaned and disinfected, and garbage from ships is incinerated unless it is kept on board and disposed of at sea (the last two outbreaks of foot-and-mouth disease in this country were traced to ships' garbage).

The U.S. Department of Agriculture has a large responsibility in supervising these entries, with a limited number of employees at ports of entry. Evidence of the effectiveness of this regulatory program is emphasized by the fact that rinderpest has never entered the United States and that foot-and-mouth disease made its last appearance in 1929.

FEDERAL-STATE RELATIONSHIPS

Federal-State cooperation in animal disease programs has been a working arrangement since 1884. It has been the basis of many effective campaigns of disease control and eradication. This is the way the partnership works:

The U.S. Department of Agriculture, through the Agricultural Research Service, is responsible for control over the interstate movement of animals and animal products involved in the outbreak of communicable animal diseases. The individual State through its livestock sanitary officials controls the intrastate movement of such animals and products.

Agricultural Research Service veterinarians are stationed in each State to work in cooperation with State livestock sanitary officials. Together they develop the necessary control and eradication measures. Under the authority of State law, they carry out the required inspections and diagnostic procedures, supervise the disposal of infected and exposed animals and the cleaning and disinfection of vehicles and premises, and carry out other measures required under the circumstances.

As part of the cooperative State-Federal disease eradication program, ARS provides specially trained diagnosticians who can be called in when vesicular diseases (those that might be foot-and-mouth disease) are suspected or reported and when other dangerous foreign animal diseases are considered likely to be present. These diagnosticians help local, State, and Federal authorities to make the diagnosis.

If the disease is diagnosed as one posing a direct threat to the Nation's livestock industry, the Secretary of Agriculture may declare a state of emergency. This declaration enables the Agricultural Research Service to enter into a cooperative arrangement with the States affected to control or eradicate the disease.

National Poultry Improvement Plan

State and Federal action is organized differently to combat some diseases of poultry. Control of pullorum disease, formerly the hardest-hitting bacterial disease of poultry, was one of the primary objectives when the National Poultry Improvement Plan (NPIP) was put into operation in 1935, as a voluntary program in which Federal and State workers and industry members pooled their efforts to improve poultry through breeding and disease control. Later the National Turkey Improvement Plan (NTIP) was organized along similar lines. These programs were broadened in 1954 to include control of fowl typhoid and salmonella infections.

The number of birds blood-tested annually for pullorum disease increased from 2 million in 1935 to more than 37 million in 1955. Incidence of the disease has dropped from more than 4 percent to less than 1 percent.

Hatchery participation has steadily increased, until about 75 percent of total U.S. hatchery-incubator capacity is now under supervision. Influence of the program is reflected also in improved standards of sanitation and disease control in hatcheries and flocks outside the plan.

The two plans are administered cooperatively by official State agencies and the Agricultural Research Service. The State agency directs, supervises, and is responsible for flock selection, testing for disease, flock and hatchery inspection, and other local administrative work involved in the operation of the plan. The Agricultural Research Service coordinates the program among the cooperating States.

The control of pullorum disease, along with great improvements in breeding and feeding and effective work on other diseases, has been a major contributor to the success of the poultry industry in this country. In the 25 years previous to the adoption of NPIP in 1935, average annual egg production advanced from 86 to 93 eggs per hen. By 1954 average production had increased to 127 eggs per hen.

THE WHY AND HOW OF QUARANTINES

The word quarantine, meaning forty, originally designated the period of 40 days during which the crew of a ship had to remain on board when the ship was suspected of carrying contagion. Since this earliest use, the word has come to mean any enforced stoppage of travel and transportation to arrest the spread of animal, plant, or human disease.

Necessarily, there is great flexibility in quarantines. Depending on the disease and all the surrounding circumstances, quarantine may range from a verbal warning, "Don't move your cattle," to strict control of the movement of animals, persons, and things, enforced by armed guards. Very often, in outbreaks of milder and less rapidly spreading diseases, quarantine is established by written notice of livestock sanitary officials to owners of animals. With some diseases the well-informed owner may establish his own quarantine.

State and Federal officials must make a careful analysis of all factors involved on the spot at the time, including the nature and current knowledge of the disease and what dislocation would be involved in the community's economic life. They must arrive at a form of quarantine that provides the necessary control over the disease while interfering least with normal life.

For instance, an outbreak of a fairly serious poultry disease in a remote location could probably be handled with little disruption of commerce. The same disease occurring in an area of heavy poultry production might have to be strictly quarantined. The disease itself may make a great difference. An outbreak of scabies in sheep might be dealt with by temporarily isolating infected and exposed animals on the farm and following a program of inspection and dipping. An outbreak of foot-and-mouth disease, on the other hand, would have to be stringently quarantined over a wide area. The quarantine would have to remain in effect until the disease was eradicated and tests made to show that the causative agent no longer existed on the premises or in the locality.

Federal quarantines are established to restrict the interstate movement of animals, animal products, and other materials, persons, and vehicles to prevent the spread of disease. State quarantines are established to accomplish the same purpose within the State. Federal and State quarantines are normally used and enforced cooperatively when both are required for the suppression and control of disease outbreaks.

The area and terms of quarantine around an outbreak of disease are usually determined by State and Federal officials working together. In the early stages of the outbreak, before its full extent is known, a quarantine might include a larger area than is found later to be necessary. If inspections show the area of infection to be smaller, the quarantine area may be reduced accordingly. Exact information on the kind and degree of quarantine imposed in a given outbreak of animal disease should be obtained from the State and Federal officials handling the outbreak. The terms of quarantine may not be immediately available at the beginning; officials in charge must have time to gather all pertinent facts of the case and reach a practical decision.

Strict quarantine, while it lasts, causes considerable inconvenience to those involved, but has proved an effective way to prevent the spread of disease. Experience has shown that the more carefully all quarantine regulations are observed, the quicker the disease can be eradicated and all restrictions removed.

CLEANING AND DISINFECTION

Careful cleaning and disinfection of contaminated premises following removal of diseased animals is one of the cardinal principles of disease eradication.

Cleaning must precede disinfection, for disinfectants cannot thoroughly penetrate organic matter in barns, vehicles, and yards. Organic matter protects disease organisms. Thorough cleaning cannot be overstressed. Manure, bedding, litter, cobwebs, dust, and all kinds of filth should be removed to a place inaccessible to livestock and burned, if possible; if not, it should be thoroughly soaked with disinfectant. Stalls, walls, mangers, troughs, and other parts of buildings used to house diseased animals should be thoroughly washed with hot water and soap or washing soda. Rotten wood, which provides easy access to disease-causing organisms, may have to be torn out and burned, to be replaced later.

With the way thus cleared for the disinfectant to act on the disease organisms, it should be applied with great liberality and thoroughness, with pressure equipment.

The use of disinfectants with strong odors in dairy barns may give milk an undesirable taste. Sodium orthophenylphenate preparations, which have no objectionable odor and are not highly poisonous, can be used in a 1-percent hot solution in dairies for disinfection after the removal of animals affected with brucellosis, tuberculosis, and Johne's disease.

The Agricultural Research Service, U.S. Department of Agriculture, evaluates the effectiveness of commercial disinfectants for specific uses, and maintains a list of those that have been approved as meeting minimum standards for official work. The choice and use of a disinfectant in each instance should be based on its tested effectiveness for the particular purpose.

Table 1 indicates what disinfectants are effective against various diseases, for disinfecting premises and vehicles. Persons dealing with the public may want to refer to this table in order to make suggestions for disinfection following the occurrence of specific diseases.

Table 1.--Disinfectants used in connection with selected animal diseases

Disinfectant	Percent solution	Mixture	Disease
Cresylic disinfectant or Phenol (USDA-Permitted, marked on can)[1]	4	1 cup to 2 gal. water	Anaplasmosis Brucellosis East Coast fever Fowl plague Hog cholera Mastitis Pullorum disease Shipping fever Swine erysipelas Tuberculosis
Sodium hydroxide (Lye)[2]	2	13 1/2-oz. can to 5 gal. water	Equine encephalomyelitis Foot-and-mouth disease Hog cholera Infectious anemia
Sodium carbonate	4	1 lb. to 3 gal. water	Rift Valley fever Rinderpest Scrapie
Sal soda (Washing soda)	10.5	13 1/2-oz. can to 1 gal. water	Shipping fever Teschen disease Vesicular exanthema Vesicular stomatitis
Sodium hydroxide (Lye)[2]	[3] 5	5 (13 1/2-oz.) cans to 10 gal. hot water	Anthrax Blackleg Glanders Malignant edema
Sodium orthophenylphenate (sold as B.T.C.) Disinfectant, Safety Disinfectant, Sofenate, and Or-thol Powder)[1]	1	1 lb. to 12 gal. water	Brucellosis Johne's disease Tuberculosis

[1]Permitted by the U.S. Department of Agriculture for official disinfection.

[2]When using lye disinfectant of any strength, wear protective goggles, rubber gloves, and coveralls. Wash areas of the body exposed to lye and treat with vinegar.

[3]When using a 5-percent lye solution in a vehicle, let it remain in the vehicle 8 hours, then wash it away before reloading with animals. Lye should be left on premises a full 24 hours.

IMMUNIZING AGENTS FOR ANIMAL DISEASES

Protection against some animal diseases is provided by the use of various veterinary biological products such as vaccines and serums. The effectiveness of such protection varies as to length and degree. Immunizing agents may not protect animals against massive and repeated exposure to infection. In combating many diseases, however, vaccination or injection with some immunizing product provides the best and most practical course available to the livestock owner. Some diseases in the United States are controlled solely by immunization, coupled with recommended sanitary measures. Hog cholera, blackleg, and Newcastle disease are examples. In combating other diseases, immunization is sometimes used along with such measures as testing and slaughter of reactors.

No animal disease has ever been completely eradicated by immunization alone. For this reason, vaccination is not used in the United States against foot-and-mouth disease and other rapid-spreading, devastating foreign diseases that occasionally appear. Vaccination in such instances often masks the infection and prolongs the eradication effort. Experience here and in Europe has proved that prompt eradication of outbreaks by the slaughter method is much more effective and less costly.

Marked progress has been made, however, by the use of immunization in reducing the incidence of diseases that have become established in this country. Deaths from hog cholera have been greatly reduced. The reduction of the incidence of brucellosis has been due in part to the use of strain 19 vaccine in young calves. Losses can often be prevented by the proper use of immunization against diseases commonly found in a locality.

Vaccines, bacterins, and serums are used to protect healthy animals from contracting disease.

Any plant or establishment in which veterinary biological products are manufactured for interstate shipment must be licensed by the Agricultural Research Service. Before the license is issued, manufacturers must present evidence, based on controlled tests, showing that the product is effective for the purposes intended. The Service must inspect and approve facilities and methods of processing; the operations and products are inspected at intervals as long as the license is in effect.

THE VETERINARY PRACTITIONER

In addition to the Federal and State veterinarians engaged in the prevention and spread of contagious animal diseases, there are about 12,000 veterinarians in private practice in the United States. Because of his acquaintance with the normal run of diseases in the community, the private practitioner is often the first to realize that there is an increase in cases of disease or that a new type of disease is present.

The veterinarian in private practice has an array of assistance available in his own State to help him in making diagnoses--State-Federal diagnostic laboratories, specialists in veterinary colleges and colleges of agriculture, agricultural experiment stations, and veterinary research institutes.

The efficiency and cooperation of the practicing veterinarian are important to the success of any animal disease program. There are not enough veterinarians in public service to carry many of the control and eradication programs to a successful conclusion. Private practitioners must be called upon to assist, and they do so, sometimes in great numbers.

Information sources may expect the practicing veterinarian to provide general knowledge about animal diseases. But he should not be expected to give out information on specific diseases in the area or on difficulties encountered by his clients, except with their consent. When he is acting as an official in a State-Federal program he can then be expected, of course, to serve as a source of information. Many public-spirited veterinarians carry on their own preventive-medicine programs of immunization and education; such individuals welcome the assistance of information outlets.

SPECIFIC DISEASES

FOR FURTHER INFORMATION

AT THE END of each discussion of a specific disease in this manual, suggested sources for further information are given.

Farmers' Bulletins, Circulars, Leaflets, etc., on animal diseases can be obtained on request by writing the Office of Information, U. S. Department of Agriculture, Washington, 25, D. C. If out of print, they are normally available in libraries.

Agriculture Yearbooks and such Department publications as Diseases of Cattle and Diseases of the Horse may be purchased from the Superintendent of Documents, Government Printing Office, Washington 25, D.C., or consulted in libraries.

Motion picture films on some animal diseases may be borrowed from the Motion Picture Service, Office of Information, U.S. Department of Agriculture, Washington 25, D. C., and from State film libraries.

Copies of Foreign Animal Diseases, Their Prevention, Diagnosis and Control may be purchased for $1.00 from the U.S. Livestock Sanitary Association, 1 West State St., Trenton 8, N.J.

ANAPLASMOSIS

CAUSE--Anaplasmosis in the United States is caused by Anaplasma marginale, a minute protozoan parasite that enters the red blood cells and destroys large numbers of them.

AFFECTS principally mature cattle, but antelopes, buffaloes, camels, and deer may be infected.

INCIDENCE--Anaplasmosis has been reported in Africa, both of the Americas, some Asiatic islands, and Europe; it may have entered Australia, which is making a determined effort to keep it out. In the United States, it has invaded more than 30 States, including all of the southern tier, northwest to Oregon, Idaho, and Montana, north to Illinois and Iowa in the Midwest, and east to Maryland and Delaware. It is gradually creeping northward.

SPREAD--Ticks appear to be the main carriers, 18 different kinds having been shown experimentally to be capable of disseminating the disease. Experiments have also shown that 7 kinds of horseflies and at least 3 species of mosquitoes can carry anaplasmosis. Unsterilized or improperly sterilized instruments can also spread the disease in the course of vaccination, taking blood samples, dehorning, castrating, ear-marking, or using nose tongs.

THE DISEASE--Anaplasmosis is a febrile, infectious protozoan disease of the red blood cells; it may be acute, subacute, or chronic. Experimental inoculation shows that it has an incubation period of 15 to 40 days, but it may take longer in natural infection. The services of a veterinarian are important in diagnosing the disease, which can be confused with tick fever, anthrax, shipping fever, and certain other diseases.

In the early stages of acute cases, the temperature may rise to 103° to 107° F. (normal in cattle is 100.5° to 102.5° F.). The temperature subsides following the acute stage of the disease and becomes subnormal before the animal dies. Heart action increases from a normal of 40 to 70 beats per minute to a pulse of 80 to 140 per minute. Breathing is labored and accelerated, rising as high as 50 to 60 respirations per minute (normal in cattle is 18 to 28). In severe cases the red-blood count drops from a normal of 6 to 8 million per cubic millimeter to 2 million or less. Blood samples can be used to aid in diagnosing the disease and determine its seriousness. Laboratory tests should be used to confirm the diagnosis. If less than 10 percent of the red cells are invaded during the febrile stage, the animal is likely to recover; if the percentage runs from 25 to 50, recovery is doubtful. However, an animal's ability to produce new red blood cells rapidly may bring about its recovery.

Other symptoms are exhaustion, debility, suspended rumination, loss of appetite, pale and yellowish color of the visible mucous membranes,

constipation, reduction of milk flow, abortion, and, when cerebral symptoms are noted, a disposition of the animal to fight. In fatal cases, death ensues in 2 or 3 days, without violent struggle. The mortality in a single herd may vary widely, but the average is about 40 percent of the animals afflicted.

Recovery is slow, requiring many days or weeks; animals that take copious amounts of water are more apt to recover.

The disease occurs mainly from June through October, and is most prevalent during seasons of excessive moisture and flood, corresponding to optimum conditions for ticks, horseflies, and mosquitoes. Mature animals are most often affected; calves under 1 year of age seldom show any visible symptoms. Recovered animals are carriers, and usually remain carriers as long as they live. (The Department of Agriculture had a cow at the Animal Disease Station, Beltsville, Md., that carried the disease until she died, 19-1/2 years after inoculation.) An infected cow may or may not transmit the disease to her unborn calf.

TREATMENT AND CONTROL--The best treatment for the disease is a daily transfusion of 8 liters (2 gallons) of normal bovine blood. Drugs that stimulate the blood-forming organs are also recommended. Tests conducted by the Department of Agriculture and several State experiment stations show that aureomycin has some value, if given early in the acute stage of the disease. Water, administered if necessary through a stomach tube, may be helpful.

Animals having anaplasmosis should be treated by a veterinarian, kept in the shade, given plenty of clean water and a little green feed, and protected against flies. Driving or rough handling may hasten their death. Recovered animals, when brought into good condition, should be sold for slaughter.

No satisfactory vaccine has been perfected for anaplasmosis. Individual animals can be made immune to infection by measured injection of the organism, but they become carriers and the aim of disease eradication is thus defeated.

Since 1944 the Department of Agriculture has been gradually improving a complement-fixation test for the detection of bovine anaplasmosis. Since smaller and less expensive experimental animals do not contract the disease, this experiment with cattle has been rather slow and costly. When the test is put into use it will be possible to detect and eliminate animals that are carrying the disease, and an eradication program may be justified.

FEDERAL AND STATE RESPONSIBILITIES--Aside from general regulations that diseased animals may not enter the United States or cross State lines, little regulation is possible on anaplasmosis until research makes possible more generally available diagnostic tests. About 400 carcasses a year are condemned by Federal meat inspection officials because of active infection with anaplasmosis.

PUBLIC HEALTH ASPECTS--There are no known cases of the disease being transmitted to man.

PUBLIC RELATIONS ASPECTS--Anaplasmosis, in certain herds and

at certain times, can take on a deadly aspect, killing more than half of affected animals. In cattle-growing regions this can cause serious apprehension, for the disease is a threat to the livestock industry. In such circumstances, information outlets should treat the matter in a calm straightforward manner. There is, however, no recourse but to tell the known facts about the disease, which cannot be too reassuring until such time as research progresses to the point where a control or an eradication program is feasible.

FOR FURTHER INFORMATION--State veterinarians and Department veterinarians in charge can provide information on the incidence and spread of the disease in a given area. Department of Agriculture Circular 154, Anaplasmosis in Cattle, is out of print.

ANTHRAX

CAUSE--Anthrax is caused by a germ, Bacillus anthracis, which thrives in the absence of air and promptly forms spores when exposed to air or to other conditions unfavorable to it. The spores are highly resistant to heat, low temperatures, chemical disinfectants, and prolonged drying. Tests have shown that the spores remain viable for 40 years at room temperature, and survive for a long time in wool, hair, soil, marshes, and ground water.

AFFECTS mainly cattle, sheep, and goats, but also occurs in horses, mules, hogs, minks, dogs, and man.

INCIDENCE--Anthrax exists in some areas of all continents and occurs from the tropics to the polar regions. It is believed to have appeared in every State in the Union. Because of persistent infection, there are well-known anthrax districts in the United States, the most widespread being the Mississippi Delta and the Gulf Coast of Louisiana and Texas, the Central Valley of California, and southeastern South Dakota, extending into the northern parts of Iowa and Nebraska.

During the 10-year period 1945-54 the five States that had the greatest number of outbreaks, affecting the greatest numbers of livestock, were California, Louisiana, Missouri, South Dakota, and Texas. There were numerous outbreaks in Arkansas, Florida, Illinois, Indiana, Iowa, Kansas, Kentucky, Mississippi, Nebraska, Nevada, New Jersey, Ohio, and Tennessee. States that reported no outbreaks in this decade were Arizona, Connecticut, Delaware, Idaho, Maine, New Hampshire, Rhode Island, Vermont, and West Virginia. Over the 10-year period there were 3,447 outbreaks in 34 States (including 475 counties in which the disease had not been previously reported), with losses of 17,604 animals.

The peak year was 1952, when 32 States reported 1,644 outbreaks of anthrax, with a loss of 3,451 animals. The increase was largely owing to the unprecedented number of outbreaks in hogs, which are generally somewhat resistant to the disease. A total of 801 outbreaks in 5 Midwestern States caused the loss of 1,406 hogs. Many of these outbreaks, especially those in Ohio, were traced to contaminated bonemeal originating in India and the Near East and imported into the United States from Belgium.

During the same decade there were 9 outbreaks on mink ranches, causing a loss of 860 animals and 2 outbreaks in zoos--Pittsburgh, Pa., and Seattle, Wash., causing the loss of 27 animals. The Meat Inspection Branch of the Department during the 10 years found 639 hogs and 40 cattle infected with anthrax at the time of slaughter.

During 1954 there were 429 outbreaks in 75 counties of 23 States, causing a loss of 1,740 cattle, 123 hogs, 103 sheep, and 333 horses and

mules. Heaviest outbreaks were in Louisiana and Mississippi. Total loss of livestock and other animals was 2,299.

SPREAD--Anthrax can be spread by contaminated soil and water; by dogs, coyotes, and other carnivores that feed on anthrax-infected carcasses; by carrion-eaters, particularly buzzards; by scavenger and blood-sucking flies and possibly other insects; by contaminated feed; and by contaminated animal products such as meat, wool, hair, furs, and even by the bristles in shaving brushes.

THE DISEASE--Anthrax is an acute infectious febrile disease, most commonly appearing as septicemia or blood poisoning. However, it has various stages of acuteness and can be confused with other diseases. The peracute or most acute form, occurring mostly in cattle, sheep, and goats, acts so rapidly that animals often show no other symptoms than sudden staggering, collapse, and death, plus bloodstained discharges from the natural openings. The symptoms of acute and subacute forms are excitement, spasms, respiratory or cardiac distress, trembling, staggering, and convulsions. The acute form usually causes death in a day or two. The subacute form lasts 3 to 5 days or longer, and may be followed by death or recovery.

Chronic anthrax, observed mainly in hogs, horses, and dogs, causes local lesions mostly of the tongue and throat. Swelling of the throat sometimes causes the death of swine by strangulation.

TREATMENT AND CONTROL--Anthrax is one of the few serious diseases of livestock that can be largely controlled by preventive vaccination. In anthrax districts, it is customary to have all livestock vaccinated in the spring, because the "anthrax season" is normally late summer when animals crop the grass close to the ground and eat some infected soil. Two types of immunizing agents are used in the United States--sterile products (anthrax antiserum and bacterin) and living-spore vaccines of various strengths.

When an animal dies suddenly of an unknown cause on or near premises where the disease has appeared before, anthrax should be suspected. Carcasses of animals that die of this disease decompose rapidly and become badly bloated. Rigor mortis is absent or incomplete. Diagnosis, supplemented by laboratory examination, should be made by a veterinarian as early as possible. The carcass should be covered with oil to repel flies, dogs, and buzzards. Then, if possible without touching or moving it, the carcass should be completely burned or deeply buried. Poles and ropes used in moving a carcass should be burned. Disinfection of premises is carried out with a 5-percent lye solution (2-1/2 lbs. lye in 5-1/2 gals. water), which should be left in barns and similar areas for 24 hours before it is washed off.

In most areas, animals showing early symptoms are promptly isolated and treated with large doses of antianthrax serum or antibiotics such as penicillin or terramycin. Well animals in an exposed herd are vaccinated with antianthrax serum, anthrax bacterin, or living-spore vaccine, and the extermination of flies is attempted on and around the premises. Anthrax vaccine, like other vaccines used in human and animal medicine, is not 100 percent perfect.

FEDERAL AND STATE RESPONSIBILITIES--To prevent anthrax from being introduced into the United States from other countries, the Agricultural Research Service permits untreated hides, skins, wool, hair, bristles, and glue stock to enter only when the appropriate official of the exporting country certifies that these products derive from animals that were free of anthrax at the time the products were taken. Raw bonemeal is prohibited, but steamed bonemeal is admitted; imported animal bones must be processed and sterilized.

The U. S. Public Health Service in 1953 issued to State milk-control authorities recommended regulations intended to prevent the spread of anthrax through milk supplies. The Public Health Service also requires that all bristles used in the manufacture of shaving brushes be sterilized to destroy anthrax spores, and that workers in plants handling wool, hair, and hides be protected against infection.

To prevent the spread of anthrax through slaughtering establishments, the Department of Agriculture condemns any animals found infected with anthrax, the carcasses are put in tankage, and the premises formerly occupied by these animals are thoroughly cleaned and disinfected. Many States have laws regulating the operation of rendering and feed-mixing plants, requiring the sterilization and sanitary handling of bonemeal and other animal products.

Anthrax outbreaks in livestock are handled by State authorities; the Agricultural Research Service assists in outbreaks when requested. Different States have different laws and regulations governing the handling of the disease and the immunizing agents that can be used. Knowledge of the disease as it appears locally is essential in order to treat it most effectively.

PUBLIC HEALTH ASPECTS--Anthrax is an acute but not highly infectious disease in man. Normally it is an occupational disease affecting farmers, veterinarians, and others who handle infected livestock or those who deal with and process infected wool, hair, hides, and skins. The disease usually occurs as a local infection of the skin, first as a pimple, then as a carbuncle, and unless promptly diagnosed and treated, it may develop quickly into blood poisoning. Human anthrax, if diagnosed promptly, is successfully treated with penicillin, aureomycin, or other antibiotics. The U. S. Public Health Service reports that in the 10-year period 1945-54 there were 483 recorded cases in man. Federal and State public health authorities take a continuing interest in human anthrax and cooperate with livestock authorities in tracing it and trying to stamp out the source.

PUBLIC RELATIONS ASPECTS--Anthrax causes great apprehension when it appears in a new area. The disease is taken for granted in infected districts, and preventive measures are a part of the annual farm routine. Information outlets can provide a public service in these areas by issuing spring reminders to vaccinate, at the same time giving salient facts about the disease. Sober, unexcited reporting is especially recommended in areas of outbreak where the disease has not occurred before, to prevent unauthorized quarantines, county embargoes, and other disruptions of normal movement and economic life. The public should be counseled to depend on State livestock sanitary authorities, who have the know-how for handling the disease. Reporters should also rely on these officials for factual information.

FOR FURTHER INFORMATION--The State veterinarian or a comparable sanitary official can provide the best local information on the disease, its character in the area, and the means used in combating it. The reporter should familiarize himself with State laws and regulations on anthrax to give him the background for prompt coverage should the need arise. The Agricultural Research Service, Washington 25, D. C., issues monthly and annual reports on outbreaks of the disease, which can be obtained on request. The subject is popularly treated in Farmers' Bulletin 1736, Anthrax, and technically in Foreign Animal Diseases, issued by the U. S. Livestock Sanitary Association. Anthrax in Ohio, a motion picture (25 minutes, 16 mm., color, sound, released 1953) produced by the Ohio Department of Agriculture in cooperation with the U. S. Department of Agriculture, is available from the U. S. D. A. The Federal veterinarian in charge of meat inspection in the State can furnish information on animals or carcasses condemned because of anthrax, and their point of origin. The U. S. Public Health officer in the State or area can give information on incidence of the disease in human beings and on the precautions to be taken.

BLACKHEAD OF TURKEYS

CAUSE--Blackhead, technically called enterohepatitis or histomoniasis, is caused by a protozoan parasite, Histomonas meleagridis, which is often carried by intestinal worms.

AFFECTS turkeys primarily, but chickens, ruffed grouse, bobwhite quail, and certain other game birds are also susceptible.

INCIDENCE--The parasite that causes blackhead was probably brought to North America in chickens from Europe and passed on to turkeys in this country. The disease is found in all turkey-producing areas of the United States, as well as in other countries where turkeys are raised extensively. In a survey (1953) of 46 States, 32 reported blackhead as ranking among their five most important turkey diseases.

SPREAD--Blackhead is a filth-borne disease dependent on carriers. Chickens contracting the disease usually recover promptly, but they remain carriers and shed the parasite in their droppings. The disease is extremely serious in turkeys, although some recover and become carriers. No practical method has been found for identifying apparently normal birds carrying the disease. The disease is also spread by contaminated feed, water, soil, and other mechanical carriers, and by the common cecum worm of poultry. The worms in the cecum (blind gut) of an infected bird may carry these organisms in their bodies; their eggs, which also carry the parasite, are passed in large numbers in the droppings of the bird. When worm eggs in contaminated feed or water are consumed by healthy turkeys, they hatch in the intestinal tract and the parasites are released in the bird's body.

THE DISEASE--Blackhead is an acute, highly fatal disease of turkeys. It is primarily a disease of the cecum and liver, but the fact that the head of the affected bird may become discolored has given the disease its popular name, blackhead. Dark discoloration of the head is not a constant symptom of the disease, however, and may be produced by certain other disorders. Blackhead can be differentiated from other diseases involving the liver and cecum, such as tuberculosis and tumors, by microscopic examination and culturing in a laboratory.

The disease may occur at any time in the life of a turkey but is most serious in young birds. The period of incubation is 15 to 21 days. Droopiness, loss of appetite, an invariable loss of weight, and sometimes a sulfur-colored diarrhea are the main symptoms. Death is often sudden. Mortality is high, often approaching 100 percent and averaging about 50 percent in uncontrolled outbreaks.

Examination of the turkey after death shows the cecum enlarged and filled with a solid, yellowish, cheesy mass, which sometimes contains

blood; the walls of the cecum may have areas that are roughened and thickened. The liver also is usually enlarged and is often spotted with dark-red, gray, or yellow circular areas, which are usually depressed below the surface rather than raised above it.

TREATMENT AND CONTROL--No drug or combination of drugs has been found entirely satisfactory for stopping losses once the disease has obtained a foothold in a flock. Nicotine products and phenothiazine, because they kill the disease-carrying cecal worms, help to prevent the disease when fed in a medicated mash. To be effective, however, they must be given early in the course of the disease and continued for the duration of the outbreak. The effect is not cumulative, and losses are likely to recur when medication is discontinued. Neither of these agents has proved effective against the disease organism itself. The only practical procedure, therefore, is the use of control measures to prevent development of the disease.

Since chickens may act as carriers of the parasite causing blackhead, turkeys should be kept completely away from chickens and from land ranged by chickens or fertilized with chicken manure. Best results are obtained with turkeys hatched in incubators and brooded artificially. The poults should be kept first in coops, houses, or runs that can be easily cleaned, and later on pasture that is known not to have been ranged by chickens or older turkeys. Any turkeys that die should be buried and any showing symptoms of the disease should be promptly removed and isolated.

FEDERAL AND STATE RESPONSIBILITIES--There are no specific Federal or State laws regarding outbreaks of blackhead. State diagnosticians and State veterinarians cooperate with turkey flock owners in diagnosing the disease and recommending preventive and control measures.

PUBLIC HEALTH ASPECTS--No case of this disease in human beings has been reported.

PUBLIC RELATIONS ASPECTS--Blackhead, if allowed to get out of control, is a serious killer of turkey poults. Information outlets can provide a public service by releases issued at turkey hatching time describing the disease, pointing out recommended preventive measures, and indicating where help can be obtained.

FOR FURTHER INFORMATION--The disease is covered in Farmers' Bulletin 1652, Diseases and Parasites of Poultry. For information concerning the disease locally, consult the State veterinarian, Federal veterinarian in charge, or extension poultry specialist.

BLACKLEG

CAUSE--Blackleg is caused by a spore-forming microorganism, Clostridium chauvei, which develops from spores into damaging bacteria only in the absence of air. The spores are very resistant to destruction by heat, cold, drying, or chemical disinfectants and, like anthrax, may exist in the soil for many years in almost any latitude, altitude, and climate.

AFFECTS principally young cattle 4 months to 2 years old. Sheep and goats are also susceptible.

INCIDENCE--Blackleg occurs in nearly all parts of the world from which definite information on animal diseases is obtainable. It ranges through all the zones of the world and is as common in mountain pastures as in the lowlands. The disease occurs in nearly all parts of the United States, but is more widespread in the great cattle-raising and cattle-feeding regions.

SPREAD--The germs of blackleg gain entrance into the body of the animal from soil and water containing the organism. It is believed that the most common method of infection in cattle is through the digestive tract. The germs can enter the body through injuries to the skin, especially in the case of sheep. The disease is not passed directly from one animal to another.

THE DISEASE--Blackleg is an acute infectious disease with such distinctive symptoms that it is usually recognized without difficulty. The most important characteristic is the appearance of swellings on the body or upper part of the legs. The swellings frequently appear on the thigh or shoulders and, because of extensive discoloration of the affected parts, as observed after skinning, the disease came to be popularly called "blackleg" or "black quarter." Slight pressure on these swellings causes a paperlike crackling because of the collection of gas formed by the organisms as they multiply. Lymph nodes near the swelling become considerably enlarged. As the swelling increases, the animal's temperature may reach 107° F., and the respiration rate may increase to more than 140 per minute. The disease is generally fatal, death usually occurring 12 to 36 hours after the first appearance of symptoms.

The carcass of an animal that dies of blackleg soon becomes much distended by gas and the legs stick out from the body. A dark, blood-colored, frothy discharge oozes from the nostrils and anus. Inside the animal, hemorrhages are found in the heart and lungs and congestion in the liver, but the spleen is usually normal.

Blackleg may be confused with anthrax, malignant edema, and shipping fever. Laboratory examination of tissue specimens is often necessary for definite diagnosis.

TREATMENT AND CONTROL--The best treatment for blackleg is to prevent it. Blackleg bacterin is a reliable and effective immunizing agent against the disease. In areas where blackleg is known to exist, it is customary to vaccinate calves in the spring to protect them through their most dangerous period--from 4 months to 2 years of age. Calves less than 6 months old sometimes contract the disease, but it is rare in those more than 2 years old. Many cattle owners, to avoid taking chances of losing animals with blackleg, follow the practice of vaccinating every 6 months all animals between the ages of 2 and 10 months. One dose of bacterin is generally considered sufficient for an individual animal. It is hoped that vaccination year after year may eventually "starve out" the disease for want of a susceptible host. Since widespread immunization began many years ago, incidence of the disease in the United States has steadily decreased.

Animals that die of blackleg should be completely burned or deeply buried in quicklime. Since the spores continue to live in the soil and can be carried near the surface by earthworms, burial should be at least 6 feet deep. If an animal dies in a barn, straw or hay should be scattered over the removal route and later burned. Stable floors and walls or the ground on which the animal died and in which it is buried should be repeatedly soaked with a strong solution of cresol (at least 4 ounces to a gallon of water).

FEDERAL AND STATE RESPONSIBILITIES--Federal regulations prohibit the movement of diseased livestock across State borders. Since blackleg is so rapidly fatal, it is seldom that a case is found in interstate transportation of animals. Federal meat inspection regulations require that any carcass found with lesions of blackleg shall be condemned and destroyed. Some States have laws or regulations on the control of blackleg.

PUBLIC HEALTH ASPECTS--None. Man appears not to be susceptible to blackleg.

PUBLIC RELATIONS ASPECTS--Although the blackleg organism is spore-forming and persists in the soil of blackleg areas, this disease does not arouse the same apprehension as anthrax. It does not spread to human beings, is readily diagnosed, and can be prevented by vaccination. Information outlets can provide a public service in blackleg areas by issuing spring reminders to vaccinate, at the same time giving salient facts about the disease.

FOR FURTHER INFORMATION--State livestock sanitary officials can provide information on areas where the disease occurs, data on losses, the customary season of occurrence (which varies in some locations), and the time of the usual vaccination. Farmers' Bulletin 1355, Blackleg: Its Nature, Cause, and Prevention, gives the facts about the disease.

BLUETONGUE

CAUSE--Bluetongue is an infectious disease caused by a filtrable virus, which is present in the blood, blood serum, tissue fluids, and organs of the affected animal. In South Africa about 15 different strains or types of the virus have been identified. It is not known how many types are present in the United States, but the Federal Laboratory in Denver is making tests on types.

AFFECTS principally sheep. Work in Africa has shown that other ruminants, particularly cattle, can carry the disease organisms and help to perpetuate the disease.

INCIDENCE--Bluetongue was first identified in Africa and has probably existed on that continent as long as sheep farming has been carried on there. Its presence in the United States was determined in 1953 by tests conducted at the Oondersteport Veterinary Laboratory in South Africa on material collected from diseased United States sheep. The disease has probably been in this country for a number of years, but it received first mention in 1948 in Texas under the name of "sore muzzle." Since then, it has been reported from year to year in Texas and also in Arizona, California, Colorado, Kansas, Missouri, Nebraska, New Mexico, Oklahoma, and Utah.

SPREAD--Bluetongue is spread by culicoides (small insects, sometimes called sandflies, midges, punkies, and no-see-ums). There is no evidence that the disease is spread by direct contact with infected animals or contaminated materials. Bluetongue is a seasonal disease, usually appearing rather suddenly in midsummer or earlier, and continuing until the first hard frost makes the vector inactive. Although sheep apparently do not retain the virus for long periods, cattle are believed to harbor the organism in their blood for several months, even though no symptoms are in evidence.

THE DISEASE--The incubation period in a natural infection is believed to be 7 to 14 days. The first symptoms are a rise in body temperature, loss of condition, and lack of interest in feeding. Later, there are swelling and inflammation of the nose, tongue, gums, and throat. The mucuous membrane of the affected parts becomes first red, then bluish or purplish. The exposed parts often bleed, and raw sores (eruptions) may form on the muzzle and in the nasal chambers. In some animals, foot lesions are seen, and the claws, coronary bands, and heels become hot, red, and painful. The animal becomes stiff and lame, weak and debilitated, and the tongue may protrude. Acute dermatitis develops, particularly of the flank, groin, and udder. The affected areas become swollen and painful. Sometimes the lower parts of the legs are swollen. All symptoms do not necessarily appear in every case.

In mild cases, recovery is usually fairly rapid. In more serious

cases, recovery is slow. If the disease is fatal, death usually occurs 8 or 10 days after symptoms first appear. An animal recovered from or vaccinated against one type of the virus is immune to that type but not to other types.

Death rates from bluetongue in the United States have not been so high as those generally reported from Africa, where mortality varies from 40 to 90 percent. Mortality rates in Texas have averaged less than 1 percent. In other States, however, losses have been nearly 5 percent. In addition to the mortality, individual flock owners have suffered severe economic losses from secondary results of the disease--screwworm infestation, weight loss, increased care, and fleece damage.

TREATMENT AND CONTROL--Research in South Africa has shown that an eradication program by the slaughter method is not effective, because even when infected sheep are destroyed, insect vectors may act as reservoirs of infection and continue to spread the disease. Experience reported from South Africa has also shown that dipping and spraying are not effective as eradication measures. In that country, the disease apparently can best be controlled by the use of an effective vaccine. Using South African techniques, a vaccine against bluetongue was developed in the United States in a cooperative program that included the Federal Government, the State of California, and the pharmaceutical industry. This modified chick-embryo vaccine was released in 1954. Screened overnight housing for sheep in summer and fall months is regarded as a good preventive measure.

Experience shows that sheep in areas where the disease is known to exist should be vaccinated in the spring to provide protective immunity by midsummer, when the disease becomes active. Infected animals should be sheltered from extremes in weather and carefully protected from sunshine as well as from rain and wind. The sick animal should be fed small quantities of soft feeds during the eruptive period, and its mouth and nose should be washed repeatedly with a weak solution of a non-irritating antiseptic.

FEDERAL AND STATE RESPONSIBILITIES--The Agricultural Research Service is establishing a diagnosis and research project at Denver, Colo., and is helping to coordinate research studies, vaccination tests, and surveys to provide wider knowledge of the disease, insect vectors, animal carriers, and control measures. ARS was instrumental in procuring the services of Dr. R. A. Alexander, Director of Veterinary Services for the Union of South Africa, for advice and consultation with United States Federal and State authorities and sheep owners. Commercial organizations are being encouraged to provide vaccine as the most effective protection against the disease now available. Federal regulations prohibiting the interstate movement of diseased and exposed animals are being enforced in areas infected with bluetongue.

Local quarantines of infected premises are enforced by State authorities.

PUBLIC HEALTH ASPECTS--No human cases of bluetongue have been reported.

PUBLIC RELATIONS ASPECTS--Because bluetongue has been so recently identified in this country, general knowledge of the disease is limited. Re-

porters can provide a public service by issuing background information to familiarize livestock owners and the general public with the facts that are known. Considerable interest in bluetongue has been aroused in areas where it has appeared, but there have been no reactions of panic.

FOR FURTHER INFORMATION--As to the disease itself, consult the Agricultural Research Service, Washington 25, D. C. For information on local disease conditions, consult the State veterinarian or the Federal veterinarian in charge in the State. The disease is technically discussed in Foreign Animal Diseases, issued by the U. S. Livestock Sanitary Association. A 9-minute 16-mm. technical color and sound movie, Bluetongue, Catarrhal Fever of Sheep, is available from the Department of Agriculture for use by veterinary students and technicians.

BRUCELLOSIS

CAUSE--Brucellosis, also called Bang's disease and contagious abortion, is caused by bacteria of the genus Brucella, of which three types are known: Brucella abortus, which most commonly causes the disease in cattle; Br. suis, most common cause of the disease in hogs; and Br. melitensis, most common cause of the disease in goats.

AFFECTS principally cattle, hogs, and goats; each is afflicted by its own type of the organism, but the types occasionally cross to other species. Horses, dogs, cats, sheep, buffalo, and fowl sometimes harbor the bacteria but are seldom affected by them in this country. Man contracts the disease from any of the three organisms.

INCIDENCE--The disease occurs all over the world. In the United States it is estimated to affect 1.5 million dairy and beef cows. Bovine brucellosis appears wherever cattle are maintained, except in sections where there is an organized program of eradication. It is most common in areas of large dairy herds. Swine brucellosis occurs wherever there are hogs and is most prevalent in the corn-hog States of the Middle West. Brucellosis of goats appears mainly in the Southwestern States.

SPREAD--Brucellosis is generally carried by infected animals. It is frequently introduced into a herd by the addition of infected replacements. As the saying goes, "it is bought and paid for." Brucella organisms are expelled by infected animals in the vaginal discharge, fetal membranes, milk, feces, urine, and occasionally by bulls and more frequently by boars in seminal fluid. Cattle and goats are most readily infected through the mouth, by contaminated feed and water, but infection is also possible through the mucous membrane of the eye and through the skin. In swine the infection is most frequently contracted by the mouth and genital tract. Since Brucella organisms survive outside the animal body from 4-1/2 hours in direct sunlight to 120 days in bovine feces in dark places, the disease can also be spread from livestock concentration points by shoes and clothing, by contaminated vehicles, and by other means.

THE DISEASE--Brucellosis is recognized as the most important single cause of abortion in cattle. Therefore, if abortion occurs in a herd, brucellosis should be suspected and the herd tested. Abortion from brucellosis usually takes place during the middle and final third period of pregnancy. Retained placenta is another symptom. Abortion and birth of weak or dead pigs is a symptom in swine, as are swelling of testicles in boars and involvement of the spinal column and leg joints. In horses, the disease sometimes takes the form of "fistula of the withers," "poll evil," and arthritis of the joints. Temporary or permanent infertility is frequently observed in cattle, swine, and goats affected with brucellosis.

The blood agglutination test furnishes a dependable basis for the control and eradication of the disease in cattle herds. A recently developed method for rapid screening of composite milk samples (called the milk ring or ABR test) is useful in detecting the presence of brucellosis in a herd. There is great economy, in technical manpower and money, in using the composite milk test--an average-sized herd can be given a preliminary screening at approximately the same cost as that for blood-testing a single animal. If this test is positive for a herd, the more definite blood agglutination test is made of each animal.

Brucellosis is estimated to affect 2.7 percent of the cattle in the United States. It causes a 20-percent milk loss valued at $35 million a year, a loss in calves placed at $7 million, and a loss in replacement of infected cows figured at $16 million. Thus, the total annual cost of brucellosis is conservatively figured at $58 million.

TREATMENT AND CONTROL--No cure is known for brucellosis in domestic animals. Many alleged cures have gained widespread endorsement because of a natural cessation of active symptoms. When tested scientifically under controlled conditions, however, none of the remedies have been found to affect the course of the disease.

A standardized live vaccine, Brucella abortus strain 19, developed many years ago by the former Bureau of Animal Industry, is an effective immunizing agent. It is mainly used on heifer calves between 6 and 8 months of age; its use in older animals interferes with blood agglutination tests. In areas where the threat of continued exposure endangers the success of eradication efforts, intelligent use of vaccine can make the difference between success and failure.

Brucellosis has been successfully eradicated in thousands of herds and hundreds of areas in accordance with established procedures. The basic plan is to make tests of the herd and promptly move the infected animals from the premises for slaughter. Herds and areas handled in this way, along with the proper disinfection and sanitary measures, are certified as free of brucellosis. In some areas, however, where the disease is so prevalent that this method would practically wipe out whole herds, modified plans are instituted. Alternative plans are intended to work toward gradual lessening of the disease so that herd owners can eventually operate under the test-and-slaughter plan.

FEDERAL AND STATE RESPONSIBILITIES--Brucellosis eradication programs are operated under joint Federal-State auspices. The Agricultural Research Service has agreements with 46 States, and together they observe uniform rules and regulations designed eventually to eradicate brucellosis. Five States--Maine, New Hampshire, North Carolina, Washington, and Wisconsin--have less than 1 percent of infected cattle and are designated as modified brucellosis-free areas. Other States are approaching this goal, which is considered an important milepost in eradication of the disease.

Increasing numbers of large cities are passing ordinances requiring that after a certain date all dairy products entering their municipal limits must come from brucellosis-free herds.

PUBLIC HEALTH ASPECTS--Brucellosis in man (also known as undulant

fever) is contracted by drinking raw milk or by handling infected animals and animal products. There is no evidence that the disease is spread from person to person. About 4,000 confirmed cases of human brucellosis a year are reported by Federal and State public health agencies. Undulant fever, regardless of the type and source of infection, is frequently a long, serious, debilitating illness, and is occasionally fatal. The disease occurs mostly in farm and packinghouse workers, sometimes in veterinarians and laboratory workers. Once the reservoirs of infection in animals are eliminated, the disease will seldom if ever occur in man.

PUBLIC RELATIONS ASPECTS--Because brucellosis is not often a fatal illness, either in animals or man, it does not arouse the same apprehension and public response as many other diseases do. Education of the public is needed, and those handling various media of information can provide a public service by presenting verified facts about the disease and the methods of control and eradication. Complete eradication of brucellosis in the United States is the goal.

FOR FURTHER INFORMATION--State livestock sanitary officials and Federal veterinarians in charge can provide information on local problems and progress. A 32-page bulletin, What Is Known About Brucellosis, is available on request from the U. S. Livestock Sanitary Association, 1 West State St., Trenton 8, N. J. The Agricultural Research Service, U. S. Department of Agriculture, Washington 25, D. C., issues statistical reports on the progress made against brucellosis after the end of each fiscal year. The National Brucellosis Committee, made up of livestock and dairy representatives, educators, packers, health authorities, livestock sanitary officials, and representatives of the farm press, farm organizations, and breed associations, issues an annual report, which can be obtained from Livestock Conservation, Inc., attention National Brucellosis Committee, 405 Exchange Bldg., Union Stockyards, Chicago 9, Ill. Further material on the human health aspects is available from the Subcommittee on Public Health Aspects of Brucellosis, National Research Council, Medical School, University of Minnesota, Minneapolis, Minn. A popular motion picture, The Triple Threat of Brucellosis, 16 mm., color, sound, 30 minutes, was released in 1951.

CHRONIC RESPIRATORY DISEASE

CAUSE--Chronic respiratory disease (popularly called air-sac infection or CRD) is caused by a pleuropneumonia-like organism, which has not yet been definitely classified as either virus or bacteria. The organism measures 0.2 to 0.5 micron (a micron is 1/1,000 of a millimeter) in diameter, whereas bacteria measure from 0.5 to 2 microns. The organism has a prolonged life in fowls and spreads slowly through a flock, infecting a large percentage of the birds. The organism is readily grown (like a virus) in chick embryos and, starting in 1952, it has been propagated (like bacteria) on artificial media with a high content of blood serum.

AFFECTS chickens and turkeys.

INCIDENCE--CRD is known to exist in Canada, the United Kingdom, and practically all over the United States, particularly in areas where poultry raising is a major occupation.

SPREAD--Within a flock, the disease spreads rather slowly, like a cold, apparently transmitted by body discharges. There is increasing evidence that it might be spread through the egg, though definite proof is lacking. It is also probably spread by mechanical carriers.

THE DISEASE--Chronic respiratory disease has symptoms very much like those of a chronic cold. There is a nasal discharge, a rattling sound in the breathing, especially noticeable at night, loss of weight, and a decline of 10 to 40 percent in egg production. In broilers, the disease occurs most often in chicks 6 weeks of age or older. Mortality may run as high as 50 percent in a flock but probably averages 10 percent or less. The disease persists for long periods.

Originally CRD was given the name air-sac infection, because birds having it were found, on autopsy, to have a frothy or yellow cheesy material in the air sacs. Chickens have 9 air sacs, which are connected with the lungs and serve as part of the respiratory system. One sac is in the neck, 4 are in the thoracic cavity, and 4 are in the abdominal cavity. The deposits caused by CRD are generally in the air sacs around the heart but may also cover air-sac spaces around the liver and intestines. Research has failed to find any essential difference between the air-sac-infecting agent in chickens and that of infectious sinusitis in turkeys.

Current methods of accurately diagnosing CRD are time-consuming, laborious, and costly. Further research is needed to develop simpler and faster methods.

CRD is an economically important disease. It suppresses egg production, and an infected flock does not again reach full production. It causes unthrifitiness and loss of weight in turkeys, and in spite of good care the birds do not attain marketable weight.

TREATMENT AND CONTROL--Several antibiotics have been tried on birds with this disease, but results have been variable and inconclusive. Very little immunity develops from having the disease. Strict sanitation and good management are helpful in preventing its occurrence. Liquidation of the infected flock is considered by some authorities to be the only feasible solution. Houses should be thoroughly cleaned and disinfected between batches of chicks. Because of the danger of potential infection by mechanical carriers, visitors from infected flocks should be kept away from poultry, and flock owners should insist that feed be delivered in new bags and that egg and poultry buyers use cleaned and disinfected crates.

FEDERAL AND STATE RESPONSIBILITIES--There are no specific Federal and State regulations relating to the movement of poultry affected with CRD. Concern about the disease led to a conference of growers and research workers at the Department of Agriculture in Washington in 1952. This meeting was followed by organization of a cooperative research program on the disease in which the Agricultural Research Service is working with researchers in 11 States--Connecticut, Delaware, Georgia, Maryland, Massachusetts, Minnesota, New York, North Carolina, Texas, Virginia, and Washington.

PUBLIC HEALTH ASPECTS--No illness associated with CRD has been reported in human beings.

PUBLIC RELATIONS ASPECTS--The presence of chronic respiratory disease in an area where many chickens and turkeys are raised can cause serious concern among poultry owners. Actually, however, losses caused by other diseases that are symptomatically similar have been attributed to CRD. But the ailment is costly and arouses much apprehension. Reporters can provide a public service by giving the facts as they are brought to light in the current research project carried on by the Federal Government and the 11 cooperating States. Investigation of the disease is relatively new, and some developments may be newsworthy.

FOR FURTHER INFORMATION--State experiment stations and State extension poultry specialists are the best source of local information. Literature on the disease is mostly confined to scientific papers.

CONTAGIOUS BOVINE PLEUROPNEUMONIA

CAUSE--Contagious bovine pleuropneumonia is caused by the micro-organism Asterococcus mycoides.

AFFECTS only cattle.

INCIDENCE--Pleuropneumonia is reported to occur in parts of Asia, Africa, Australia, and the Soviet Union. It is essentially a disease of dry countries, although it occurs, or has occurred, in most parts of the world. Imported cattle introduced the disease into the Eastern United States about the middle of the 19th century, and by 1886 it had spread westward to Ohio, Illinois, Kentucky, and Missouri. It was the spread of this disease that led to the establishment of the former Bureau of Animal Industry in the U. S. Department of Agriculture in 1884. Through a Federal-State program of research and eradication, the disease was entirely stamped out by 1892, and it has not appeared in this country since.

SPREAD--Under natural conditions, pleuropneumonia is spread by means of the respiratory and alimentary tracts. There is some evidence to show that, under certain conditions, stables may retain the infection for a considerable time and that when they are restocked the disease may break out again from such infection. The infection may persist in the affected parts of the lungs of recovered animals for several months. Such animals remain a potential source of infection. Latent carriers may harbor the infection for 2 to 3 years before they transmit the disease.

THE DISEASE--Pleuropneumonia may be peracute, acute, or subclinical. The peracute form, in which the pneumonia lasts but a few days, is uncommon. The acute form is most frequently observed. In the early stages, there is a rise in temperature, the coat is rough, and the animal appears dull and loses its appetite. Later, typical symptoms appear: a cough (at first dry and painful, subsequently moist), labored breathing, and grunting expiration. The animal stands with the elbows turned outward almost invariably facing into the wind, with nostrils dilated and the head extended to relieve pressure on the chest. In the later stages, there may be a discharge from the nose containing mucus and pus, and sometimes fluid gathers beneath the skin of the lower part of the chest. The animal loses flesh rapidly and finally lies down--always on the side of the affected lung. In the subclinical form, symptoms are less marked and usually escape observation. Swellings at the joints are sometimes seen in young calves.

The incubation period is usually 3 to 6 weeks, but reports indicate that it may be as short as 10 days or as long as 10 weeks. Usually the disease spreads slowly in an infected herd. In general, about 40 percent of the exposed animals contract the disease and about one-half of the affected animals die.

Post-mortem examination shows that, in ordinary acute cases, infection is usually restricted to one lung. The pleural cavity on the affected side contains a varying quantity of straw-colored or reddish fluid in which are floating yellowish flecks and strands of fibrin (coagulating agent of the blood). The affected part of the lung is usually adhered to the chest wall by a yellow spongy mass of tissue. The diseased lung tissue does not collapse but appears raised above the more normal portions. It is solid, and the freshly cut surface has a marbled appearance; areas of pink, dark-red, and grey lung tissues are marked off by yellowish "veins" of varying width. (The "veins" are the thickened tissue partitions separating the lobules of the lungs.) In animals that are recovering, it is usual to find the affected portion of the lung enclosed in a thick fibrous capsule, which may vary in size from a pea to a large orange. Eventually this may be absorbed, or it may become liquefied and appear like an abscess. In many old cases of pleuropneumonia the only evidence of past infection may be the thickened pleura and firm adhesions between the lung and chest wall, together with thickening of the "veins" in the area adjacent to the adherent serous membrane of the lung.

In a living animal, it is difficult to distinguish pleuropneumonia from pneumonia and pleurisy of other origin. A specimen of lung preserved in glycerine, together with another specimen in formalin, should be submitted to a diagnostic laboratory for examination. The naked-eye appearance of the lung lesions is usually sufficient for a skilled diagnostician to make a definite diagnosis.

TREATMENT AND CONTROL--There is no specific treatment for pleuropneumonia. An outbreak of this disease in the United States would be eradicated by the same methods as those used for foot-and-mouth disease. Quarantine and diagnosis would be followed by appraisal and prompt slaughter of affected and exposed animals and cleaning and disinfection of the infected premises.

FEDERAL AND STATE RESPONSIBILITIES--In the event of an outbreak of pleuropneumonia, a Federal-State agreement would be reached immediately, and the disease would be handled through a Federal-State cooperative program of eradication.

PUBLIC HEALTH ASPECTS--No cases of this disease in human beings have been reported.

PUBLIC RELATIONS ASPECTS--Although pleuropneumonia, once established, is a serious menace, it does not spread as fast as foot-and-mouth disease. However, any disease that requires slaughter of infected and exposed animals creates some alarm among livestock owners. Announcement should be withheld until definite diagnosis is made. Information about an outbreak should include assurances that human health is not involved, that the disease does not spread as fast as foot-and-mouth disease, and that experienced professional men are in charge of the situation.

FOR FURTHER INFORMATION--This disease is rather fully discussed in the U. S. Department of Agriculture publication, Diseases of Cattle. A technical discussion appears in Foreign Animal Diseases, issued by the U. S. Livestock Sanitary Association. Bovine Contagious Pleuropneumonia, an Australian-produced motion picture (16 mm., color, sound, 29 minutes) is available from the U. S. D. A.

DOURINE

CAUSE--Dourine, also called equine syphilis, is caused by Trypanosoma equiperdum, a protozoan parasite of microscopic size.

AFFECTS horses and donkeys.

INCIDENCE--Dourine has appeared in various countries of Asia, Europe, Africa, and South America. It was introduced into Illinois by a French stallion in 1886, which caused the first known outbreak in the United States. The disease spread from this point, and later appeared in Arizona, California, Colorado, Idaho, Iowa, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oregon, South Dakota, and Wyoming. A determined Federal-State program of eradication and the gradual reduction of horse numbers in the United States have greatly decreased the importance of the disease in this country. The greatest difficulty in eradicating the disease was in open range areas. By 1942 dourine was known to exist only in Arizona, California, and Nevada. It is now confined to the Papago Indian Reservation in south central Arizona, which is adjacent to other Papago lands in Mexico. Papagos ride across the border to exchange visits and attend fiestas in Mexico--and their horses propagate the disease.

SPREAD--Dourine is spread only by breeding.

THE DISEASE--Dourine is a French word apparently derived from the Arabic darin, meaning "unclean." The disease generally appears in two distinct stages. The first affects the external genitals of both male and female, beginning 8 days to 2 months after exposure to infection. Small vesicles or blisters appear, which soon rupture and form raw, irregular ulcers that heal with prominent white scars. The second stage is marked by nervous or constitutional disturbances that may not appear for months or even years after the first stage. Wheals or plaques, resembling hives, occur on the skin and may, after they subside, leave areas of white skin or white hair. Advanced cases are marked by loss of flesh, nervousness, and paralysis. The hind legs are most commonly affected by the paralysis, causing the animal to stub or drag a toe while walking. After the hindquarters become paralyzed, the disease usually progresses rapidly. Unable to stand, the animal goes down and soon dies in a state of nervous exhaustion.

TREATMENT AND CONTROL--No satisfactory medical treatment has been found for dourine, nor has it been possible to immunize horses against the disease. A good diagnostic method was found in 1912--applying a serological test (complement-fixation) to blood serum taken from animals of breeding age. Since some animals may survive and serve as potential spreaders, the only effective method of handling the disease is to slaughter those showing a positive test for dourine.

Range horses on the Papago Indian Reservation in Arizona are usually rounded up for tests during the dry season, when water is scarce. The water holes are fenced and all those in a certain area are closed until the horses become intensely thirsty. The gate to one water hole is then opened, and all available horses are permitted to enter or are driven in. The gate is closed and the horses are roped one by one and blood samples taken. The horses are then turned into an adjoining fenced enclosure and held until complement-fixation tests have been run at U. S. Department of Agriculture laboratories in Washington, D. C. Positive reactors are slaughtered and paid for, and the rest are released. The search for reactors then moves to another area.

FEDERAL AND STATE RESPONSIBILITIES--All horses offered for entry into the United States from countries where dourine is known to exist must pass a blood test for dourine at the port of entry before they are permitted passage into the country. Those with a positive reaction must be destroyed or returned to the country of origin. During 1952, of 1,156 horses subjected to this test, only 1 positive reactor was found. One reactor, of course, could start an epidemic, as did the French stallion in 1886. Since it is generally known, however, that these tests are required, shippers are very reluctant to risk shipping unhealthy animals and having them slaughtered or having to pay return freight.

Within the States, the State and Federal Governments usually share equally in indemnifying owners for animals destroyed.

PUBLIC HEALTH ASPECTS--No human cases have been reported.

PUBLIC RELATIONS ASPECTS--Since the decline of the horse in American life, dourine is not the threat it once was, hence it arouses no great apprehension on the part of the general public. Should the disease appear in a community having a primary interest in blooded horses, however, it would be serious to those concerned. Information sources, in these circumstances, can only give the basic facts about the disease and the news about its occurrence.

FOR FURTHER INFORMATION--Farmers' Bulletin 1146, Dourine of Horses (out of print), has information on the disease, which is also discussed in Diseases of the Horse published by the Department of Agriculture. State and Federal veterinarians can provide information on incidence of the disease in local areas.

EAST COAST FEVER

CAUSE--East Coast fever is caused by a protozoan organism called Theileria parva.

AFFECTS only cattle, the African buffalo, and the Indian water buffalo.

INCIDENCE--East Coast fever occurs along the coastal regions of equatorial East Africa, from which it has spread to Rhodesia, the Transvaal, Natal, Swaziland, and probably other parts of Africa. It has occasionally appeared in inland areas with altitudes of 7,000 to 11,000 feet but usually dies out after the first winter. It is not known to exist outside of Africa but is an object of apprehension in many countries, including the United States.

SPREAD--This dread disease is not transmitted from animal to animal, but only by the agency of ticks, principally the brown tick, Rhipcephalus appendiculatus. Other vectors are the Cape brown tick (Rh. capensis), the red tick (Rh. evertsi), and the black-pitted tick (Rh. simus). The protozoa is not passed from the adult tick to the egg, so the larvae, which hatch about 4 weeks after the eggs are laid, are not infected. They attach themselves to a passing host and remain there for 3 to 7 days, then drop off and moult to form nymphs in about 3 weeks. The nymphs attach themselves to a host for about the same length of time, then drop off and moult to form adult ticks after 10 to 18 days. The adults remain on the host for 1 to 3 weeks. The disease is transmitted only by a nymph that received the infection during its larval stage or by an adult tick that obtained the infection during its nymphal stage.

THE DISEASE--East Coast fever is a highly fatal disease of cattle. The period of incubation is usually 10 to 15 days. Infected animals normally show no indication of illness for the first few days, except a rise of temperature, to 106° or 108° F. Then the appetite gradually wanes, rumination (cud-chewing) ceases, the coat becomes rough and loses its luster, milk secretion decreases, there is excessive salivation and lachrymation, the muzzle becomes dry, the ears droop, and the lymphatic glands begin to swell. After a time, breathing becomes difficult, a short cough develops, there may be constipation, but diarrhea begins on the eighth or tenth day; the feces are blood-tinged, tarlike, and slimy. At the height of the fever as many as 75 to 90 percent of the red corpuscles are invaded by the causative organism, T. parva. As the disease advances the lymphatic glands become larger and more prominent, the animal becomes weak, emaciated, dull, and depressed, the lungs fill with serous fluid, and the animal usually goes down, while large amounts of white froth escape from its nostrils. The animal may die of asphyxiation at this point. The animal becomes delirious and lies in a comatose state until death ensues. The disease develops rather slowly, usually running a course of 10 to 12 days after the first temperature reaction. All the animals in a herd may

become infected, and a death rate of 95 percent is not uncommon. Solid immunity is conferred by recovery from the disease.

TREATMENT AND CONTROL--No drug or vaccine has been found that will cure or immunize against this disease, so prevention is the usual practice in areas of occurrence.

Eradication of the tick is the method most commonly used, by dipping the animals at 3-, 5-, or 14-day intervals. Five-day dipping is preferred, using a 0.2 percent arsenite of soda solution (2 pounds of arsenite of soda to 100 gallons of water). The dip is more effective if 1 gallon of nicotine sulphate is added to each 1,000 gallons of arsenical dip. Hand dressing of ears and tail region is important. In Natal, where the disease is most prevalent, and where short-interval dipping is used, large forces of men are necessary to maintain quarantines and carry out the dipping. In spite of these measures, control only is established and the disease is not eradicated.

A second method is to combine slaughter with the use of a series of quarantine camps. The temperatures of all cattle on the infected farm are taken and those showing a fever are immediately slaughtered. The other animals are moved to a quarantine camp, where their temperatures are taken every morning for 16 days and those with fever are slaughtered. The disease-free animals are moved to a second camp, where this 16-day routine is repeated, with slaughter of reactors. By the time they are moved to a third quarantine the survivors should be free of the disease: The inoculation period is 14 days, and the moulting period of the larvae is 16 days. No cattle should be permitted on the infected farm or at the first and second quarantine camps for 15 months, it having been determined that the infection dies out in the tick after one year. Horses, donkeys, sheep, and goats may use the previously infected areas, since the ticks purge themselves of the infection when they suck blood from nonsusceptible animals.

A third and more drastic method of dealing with this disease is strict quarantine and slaughter of diseased and contact animals. This is the most effective and in the long run the most economical way of dealing with the disease; East Coast fever was completely eradicated from the Mozambique by using this method. Should this disease ever enter the United States, it is most probable that the stamping-out method would be used.

FEDERAL AND STATE RESPONSIBILITIES--Federal regulations prohibit the entry into the United States of animals having rinderpest, foot-and-mouth disease, and "other diseases." East Coast fever is one of the "other diseases." Owners of cattle imported from countries free of foot-and-mouth disease must have a permit in advance from the Agricultural Research Service and the animals must be quarantined for 30 days at the port of entry after arrival in this country. These regulations are designed to detect occurrence of such a disease as East Coast fever in cattle being imported into the United States.

PUBLIC HEALTH ASPECTS--So far as known, the disease has never appeared in human beings.

PUBLIC RELATIONS ASPECTS--A deadly disease like East Coast fever,

if it occured in the United States, would no doubt cause much the same apprehension and panic as foot-and-mouth disease. Information sources can provide a public service by reporting the facts as they develop, with down-to-earth background information about the disease.

FOR FURTHER INFORMATION--The U. S. Department of Agriculture has (1956) no publication dealing with East Coast fever. This summary is based on a more extended treatment in Dr. M. W. Henning's Animal Diseases in South Africa (1949), with additional information by Department of Agriculture scientists. The disease is technically treated in the U. S. Livestock Sanitary Association's Foreign Animal Diseases. East Coast Fever, a motion picture (16 mm., 20 minutes, color, sound) produced in South Africa, is available from the U. S. D. A. State and Federal veterinarians with a background in exotic diseases, both in Washington and in field offices are able to furnish further information.

EQUINE ENCEPHALOMYELITIS

CAUSE--Equine encephalomyelitis, popularly known as sleeping sickness or brain fever, is caused by a specific filtrable virus, of which two types--the eastern and the western--are known in the United States. The eastern type is the more virulent. Recovery from and immunity to one type does not protect against the other. (A third type, called the Venezuelan, more virulent than our strains, has appeared in Colombia, Ecuador, Panama, and Venezuela.)

AFFECTS horses, mules, and donkeys, and was once thought to affect them alone. Experimental passages of the virus into other kinds of animals have shown, however, that it can infect more species of animals than perhaps any other known virus. More than 50 species of birds, rodents, ruminants, and other kinds of animals have been artificially infected. The disease is also naturally transmissible to man. It is possible that still other kinds of animals may harbor the virus without being clinically affected by it.

INCIDENCE--Encephalomyelitis occurs in both hemispheres and has been reported in every State except New Hampshire, Pennsylvania, Tennessee, and West Virginia. Since the Department of Agriculture began keeping a record in 1935, more than half a million cases have been reported among equines. (During the epidemic decade of the 1930's it was unofficially and perhaps accurately estimated that there were a million cases.) The worst years were 1937 and 1938, when 173,889 and 184,662 cases were officially reported. The lowest year of record was 1951, with 762 cases. Since 1945, the occurrence has leveled off at about 3,000 equine cases a year, averaging about 40 percent mortality from both types of infection. In 1953 there were 3,142 cases reported from 34 States, the heaviest infection occurring in Florida, Kansas, Missouri, Nebraska, North Dakota, Oklahoma, and South Dakota. Canada and Cuba also reported outbreaks during 1953.

SPREAD--Mosquitoes are the principal carriers. They are known to have spread the Venezuelan strain from that country across 6 miles of water to the island of Trinidad. Ticks, biting flies, and assassin bugs have also been incriminated. The seasonal occurrence of the disease--July through October--is in a period when warm, wet conditions are most suitable for the propagation of mosquitoes. Animals kept in screened stables and in cities seldom get the disease; it occurs principally on pastures and ranges. The disease has not been known to pass from one animal direct to another.

THE DISEASE--The name comes from two Greek words, encephalon (brain) and myelon (spinal cord), plus the suffix -itis (an inflammation of).

Encephalomyelitis occurs in three distinct stages, although the first may pass unnoticed by the casual observer. This consists of a mild in-

disposition with a temperature above 102° F., sometimes running as high as 107° F. During this stage, the virus circulates and multiplies in the blood. In some animals the disease stops at this first stage, but in others it may pass to the second stage, affecting the central nervous system.

The second stage is characterized by distinct nervous symptoms, with or without fever. Symptoms vary, but often the animal becomes very drowsy and stupid. When aroused, it may take water and feed, then go into a dreamy state with the food in its mouth unchewed. It yawns, grinds its teeth, twitches various muscles, walks with a staggering or stumbling gait. Some horses become highly excited, whinny a great deal, lunge about, and back or butt into the stall or fence. There is likely to be paralysis of tongue and throat so that the animal cannot swallow. This results in a foul-smelling discharge from mouth and nostrils, caused by feed held in the pharynx and the passage of feed and water through the nasal area.

In the third and final stage the animal goes down. It may lie quietly and snore heavily or make running movements and beat its head on the ground. There is rapid loss of weight because of dehydration, and the animal usually dies rather quickly. Mortality may be as high as 100 percent with the eastern type virus and as low as 20 percent with the western type. Incubation period of the disease is usually 3 to 10 days, in exceptional cases as long as 3 weeks.

TREATMENT AND CONTROL--No effective treatment or cure has been found, even among the so-called wonder drugs. The best treatment is prevention by the use of an encephalomyelitis vaccine that protects from both the eastern and western types of the virus. Two doses should be administered at 7- to 10-day intervals, allowing 2 weeks after the second for immunity to develop. Immunization should be complete by early July in most areas, and vaccination should be repeated each year.

Prevention of mosquito bites is perhaps equally important; all possible methods of mosquito exclusion and eradication should be used. Animals should be stabled at night if at all possible. Animals being moved from an uninfected to an infected area should be immunized before the move. A veterinarian's services are highly important for diagnosis and care. The disease can be confused with many other ailments, including anthrax, swamp fever, moldy corn poisoning, rabies, lockjaw, and even lightning stroke.

The veterinarian can provide certain treatments according to the condition of the animal, such as stimulants, sedatives, laxatives, catheterization, etc. Unguided home treatment can result in loss of livestock. Animals dead of the disease should be promptly disposed of by rendering, burning, or deep burial in quicklime. Stables, sheds, corrals, and other premises should be thoroughly cleaned and disinfected with a 2-percent lye solution or a 1-percent formalin solution. If lye is used, it should be removed after a few hours by repeated washing with clean water.

FEDERAL AND STATE RESPONSIBILITIES--The Department of Agriculture is obliged by law to prevent the entry of diseased animals into the United States; it establishes sanitary restrictions against the importation of horses from areas where there is an outbreak of encephalomyelitis, such as those against Cuba in 1953. The Federal Government can also

exercise its authority over interstate movements to prevent spread of the disease. Control of the disease has been for the most part handled by State livestock sanitary officials through restrictions on the movement of affected animals within the State.

PUBLIC HEALTH ASPECTS--Equine encephalomyelitis is a serious disease of human beings, who apparently also contract it from mosquito bites. The eastern type causes a high mortality among children and permanent damage to those who survive. The western type causes less serious illness but has been more common; 2,000 human cases were reported in five Midwestern States during the peak year of 1941. A vaccine of the type used on horses has been refined for human use; immunization with this vaccine is recommended under conditions of unusual exposure to the disease.

PUBLIC RELATIONS ASPECTS--Although encephalomyelitis is a very serious disease, both of horses and of people, it seldom arouses great public apprehension except in times of outbreaks. To prevent epidemics, information outlets can provide a public service by issuing spring reminders, in areas where the disease occurs, to vaccinate horse stock well ahead of the season of principal occurrence. The serious nature of the disease can be stressed, together with other preventive actions that can be taken, such as screening barns, stabling animals at night, and exterminating mosquitoes.

FOR FURTHER INFORMATION--State veterinarians, Federal veterinarians in charge, and public health authorities are prime sources of information on the disease in any given area. The Department has no separate bulletin on this subject, but it is treated in Diseases of the Horse, published by the Department, and in technical literature. The Department issues a multilithed annual report on the disease, showing areas of occurrence during the calendar year, number of cases, percentage of deaths, and other pertinent information by States and regions. The Venezuelan type of equine encephalomyelitis is technically described in Foreign Animal Diseases, published by the U. S. Livestock Sanitary Association.

FOOT-AND-MOUTH DISEASE

CAUSE--Foot-and-mouth disease is caused by a filtrable virus, estimated by British investigators to measure five ten-millionths of an inch in diameter; like that of poliomyelitis, it is one of the smallest known viruses. Found in Germany in 1898, it was the first filtrable animal virus ever isolated. Three types of foot-and-mouth virus--A, O, and C--are widely recognized. South African types 1, 2, and 3 have been identified by British scientists, but have not been observed outside Africa. Variants are known within all types.

AFFECTS cloven-footed animals, primarily cattle, swine, sheep, and goats; wild animals such as deer, buffalo, and antelope; hedgehogs and guinea pigs.

INCIDENCE--Foot-and-mouth disease is prevalent from time to time, to a greater or lesser degree, on parts of the continents of Africa, Asia, Europe, and South America. It has occurred in nearly every major livestock-producing country in the world. North America, Central America, and Oceania (Australia and New Zealand) are generally considered to be free of the disease, but most of them have had outbreaks. Australia had foot-and-mouth disease in 1872, the last reported occurrence. The United States has had 9 outbreaks, the first in 1870, the last in 1929. Mexico had a widespread epidemic in 1946-52 and a lesser one in 1953. Canada had a small outbreak in 1952-53.

SPREAD--Foot-and-mouth is a highly communicable disease. Especially during the febrile period of 5 to 7 days, the virus is present in the vesicles (blisters) and in the blood, organs, excretions and secretions of infected animals--even in the semen of infected bulls. The disease can be transmitted in the meat and milk of infected animals, in butter and cheese, and in curds and whey. Most of the outbreaks in the United States since the turn of the century have been traced to meat scraps from incoming ships that were fed to hogs, one has been definitely traced to contaminated vaccine, and one is thought to have come in on hay, ropes, or hides.

The disease can be carried mechanically on the feet of farm animals, on the footwear and clothing of people, by hay, straw, feed sacks, milk containers, and on the bodies and wheels of vehicles. The virus is rapidly destroyed by direct sunlight and heat, but it may survive several months in sheltered spots on premises; in one case it is known to have persisted for 345 days in hay. The virus remains infective in frozen or refrigerated meats for many months and, when dried rapidly under a vacuum at a low temperature, it lives for several years.

THE DISEASE--Visible symptoms are vesicles (blisters) on the tongue, dental pad, lining of the mouth, between the toes, around the top of the hoof, and on the teats and udder of females. The blisters soon break, leaving a

raw, eroded surface, which invites secondary infections of various types, especially in the feet. In extreme cases the hoofs are sloughed off. The mouth condition is so painful that the animal refuses feed, and the feet may become so sore that it limps heavily or lies down. Excessive frothy drooling is a characteristic symptom. Because of illness and lack of food, infected animals rapidly lose condition.

There is a great reduction of milk flow in dairy herds, mastitis may develop, pregnant animals often abort, and breeding animals frequently become sterile. Death losses are not usually high in adult animals--seldom more than 5 percent--except in especially virulent attacks, but in young animals they may run 50 percent. Animals that recover are often physically impaired. They usually have a natural immunity to the disease for about 1 year after recovery.

The incubation period of natural infection is normally 2 to 5 days, but may be longer. Animals inoculated with the virus, as when diagnostic tests are being made, usually contract the disease in 24 to 48 hours.

TREATMENT AND CONTROL--The vesicular diseases (those causing blisters in the mouth and on the feet and teats) are given prompt attention in the United States. They include vesicular exanthema (VE), vesicular stomatitis (VS), and foot-and-mouth disease, the visible symptoms of which are almost identical.

The first step in handling a vesicular disease is for the livestock owner or veterinarian to report it to the State livestock sanitary officer, who works on these cases with the Federal veterinarian-in-charge. They make a preliminary investigation and, if their findings warrant, call in a specially trained U.S. Department of Agriculture diagnostician to identify the disease. Biological and laboratory tests are made, with results usually available in 48 to 72 hours.

If the disease is foot-and-mouth, appropriate quarantine is quickly established, inspectors are brought in to determine the extent of the outbreak, and work is begun on the slaughter and burial of infected and exposed animals. Body cavities of the carcasses are slashed, the animals are sprinkled with lime and covered with earth. The premises are thoroughly cleaned and disinfected. Susceptible animals are placed on the premises to test the adequacy of virus eradication measures; they are inspected frequently and kept there for a period considered sufficient under the circumstances. Thereafter the area is released from quarantine for restocking by the owner.

This is the stamping-out method, which is favored by the United States, Australia, Canada, Eire, Great Britain, New Zealand, Northern Ireland, Norway, the Rhodesias, and South Africa. This method is based on the experience that it is better and more economical to slaughter quickly, thus eliminating the virus and protecting the many by slaughter of the few.

A few countries use the stamping-out method with vaccination when considered appropriate. Countries using this combination include Denmark, Finland, the Netherlands, Sweden, and Switzerland.

In countries where the disease appears frequently and affects a large proportion of the animals, slaughter is seldom used and more dependence is placed upon vaccination. This is true in such countries as Belgium,

France, Italy, Spain, West Germany, and the South American countries. In a study made in France of the comparative cost between eradication and vaccination, it was shown that France found it as expensive to vaccinate as Great Britain to eradicate, and France still had the disease, plus millions of dollars of economic loss.

A British committee of the Ministry of Agriculture and Fisheries, after exhaustive study of the foot-and-mouth problem, concluded in 1954 that vaccines against one or two types of the disease can provide 90 percent protection but "it would not be safe to reckon on full immunity lasting for more than four months." All in all, the committee decided, "In the circumstances of today, and of the immediate future as far as they are foreseeable, any idea that it would be possible to do away with stamping-out by making the whole susceptible animal population--or even all cattle--immune by vaccination is in the realm of fantasy. In present circumstances stamping-out must continue to be the policy in Great Britain." This is closely parallel to the attitude in the United States: That vaccination cannot eradicate the disease, it is expensive, and its use necessarily prolongs the eradication program until after any possible immunity afforded by vaccination has disappeared.

There is no recognized specific cure for foot-and-mouth disease. Veterinarians feel that any treatment can only alleviate symptoms while this highly contagious disease spreads farther.

FEDERAL AND STATE RESPONSIBILITIES--Federal-State agreements for prompt cooperative action in case of an outbreak of foot-and-mouth disease can be quickly put into effect. Once diagnosis is made, Federal and State authorities promptly swing into a cooperative program of eradication, each paying half of the indemnities for slaughtered animals.

PUBLIC HEALTH ASPECTS--Man is very rarely infected with foot-and-mouth disease, though persons are extensively and repeatedly exposed to it in many countries. There have been a few authenticated cases of such infection--a mild involvement of the mouth and between the fingers and toes. But the disease is not a public health problem.

PUBLIC RELATIONS ASPECTS--No other disease of livestock is quite so likely to cause apprehension among livestock owners and the public.

In the event of an outbreak, calm and responsible reporting can help allay anxiety. People in and near the outbreak area may need to be reassured that control measures will cause no food shortage and that the disease poses no threat to human health. They should be asked not to travel in the quarantine zone unless absolutely necessary, to comply fully with all quarantine and disinfection requirements, and to refrain from repeating unconfirmed rumors. Hearsay and scarehead reporting have been known to do great damage to the prosecution of an eradication campaign. Down-to-earth factual information can be obtained from headquarters of the outbreak.

FOR FURTHER INFORMATION--Accurate local news will be available from the headquarters of an outbreak--State and U. S. information men with special background on this disease will be on the job. Information

from a national point of view can be obtained from the Agricultural Research Service, U. S. Department of Agriculture, Washington 25, D. C. Farmers' Bulletin 666, Foot-and-Mouth Disease, gives popular information on the ailment, which is technically discussed in Foreign Animal Diseases, issued by the U. S. Livestock Sanitary Association. A motion picture, Outbreak, 16 mm., color, sound, 29 minutes, was released by the Department in 1949. Three other 16-mm. color-and-sound films are also available from the U.S.D.A.: Epidemic--Foot-and-Mouth Disease in Canada (16 minutes), Foot-and-Mouth Disease in Mexico (20 minutes), and Foot-and-Mouth Disease in South Africa (15 minutes).

FOWL PLAGUE

CAUSE--Fowl plague (also called fowl pest) is caused by a filtrable virus, estimated to be 60 to 90 millimicrons in diameter.

AFFECTS chickens, turkeys, pheasants, and, to a far lesser extent, ducks and geese.

INCIDENCE--Fowl plague has occurred in many countries of Europe, Asia, Africa, and North and South America. It reached the United States for the first time in 1924, and outbreaks occurred in Delaware, Illinois, Michigan, Missouri, New Jersey, New York, Pennsylvania, and West Virginia. The disease reappeared in Morris County, N. J., in 1929 and was promptly eradicated before it spread beyond the limits of the county. At the present time, the disease is not known to be a problem in any country, although the infection may be present in parts of the world from which little information is available.

SPREAD--Although the exact means of spread is not definitely understood, the disease is communicated by direct contact, possibly through the respiratory or digestive tracts. Once the disease hits a flock, it spreads rapidly and kills all or nearly all of the chickens in a short period of time. The history of every outbreak in this country shows that new birds had been introduced, birds had been in contact with neighboring flocks that were sick, a poultry buyer brought in dirty poultry crates, a dead bird from some other source was found on the premises, or poultry offal was fed to the flock. That spread requires rather close contact with infection is also shown by the fact that quarantine measures and slaughter readily control the disease.

THE DISEASE--Fowl plague is an acute, infectious, febrile, virus disease. Incubation period is 48 to 72 hours. The disease is so acute that many birds die after showing only a slight indisposition, loss of appetite, ruffled feathers, and fever. In a longer course, some diarrhea may develop. The head parts may be somewhat discolored. Eventually, some birds show formation of fluid under the skin (edema)--a condition highly suggestive of plague. This is most often noticed in the wattles, face, comb, and entrance to the thorax or posterior end of the keel. The hock joint and toes are occasionally involved, causing lameness. The eyes and nostrils may have a slight watery discharge, and sticky mucus may be found in the mouth. Rather large purplish blotches or spots may develop on the scaled portion of the legs. The virus is highly concentrated in all fluids and tissues of the body as well as in secretions and excretions, the amount varying in different organs and in different components of the blood. A highly significant indication of the disease upon post-mortem examination is hemorrhages in the tissue beneath the linings of body cavities. The organs show few changes beyond congestion.

Fowl plague is likely to be confused with highly fatal forms of Newcastle disease. The consistent presence of rather extensive hemorrhages on the lining of the proventriculus (glandular stomach) and beneath the lining of the gizzard not only helps to differentiate plague from Newcastle disease but from all other diseases as well. The positive differentiation of these diseases must be performed in the laboratory by injecting suspected material into chicken eggs containing live embryos and recovering the virus.

TREATMENT AND CONTROL--No treatment is known for fowl plague, and, except for an inactivated vaccine that produces only a short-time immunity, no vaccine has been developed for field use. Any sudden outbreak of an ailment that causes quick and high mortality in a poultry flock should be reported at once to the State veterinarian or the Federal veterinarian in charge, so that, if the disease is fowl plague, Federal-State eradication activities may begin before the disease spreads.

FEDERAL AND STATE RESPONSIBILITIES--The entry of poultry and certain game birds into the United States from foreign countries (except Canada) is prohibited by Federal regulations unless these conditions are met: (1) A permit is obtained from the U. S. Department of Agriculture in advance of shipment, (2) a certificate accompanies the shipment, signed by a veterinarian employed by the national government stating that the birds are free of disease and exposure to disease, and (3) birds apparently in good health are permitted to enter, subject to quarantine for a minimum of 15 days at the first port of arrival.

An outbreak of fowl plague would probably be eradicated by methods similar to those used for foot-and-mouth disease. Through a Federal-State cooperative program, quarantine and diagnosis would be followed by prompt slaughter of affected and exposed chickens and cleaning and disinfection of the infected premises.

PUBLIC HEALTH ASPECTS--No case of this disease in man has been reported.

PUBLIC RELATIONS ASPECTS--Fowl plague, if it were to break out in this country, would create alarm among poultry raisers. Announcement should be withheld until definite diagnosis is made. The facts should be reported calmly, poultrymen encouraged to report suspicious or sudden deaths among their flocks, and assurance given that experienced professional men are in charge.

FOR FURTHER INFORMATION--Fowl plague is discussed rather fully in Diseases of Poultry, published by the Iowa State College Press, Ames, Iowa, and in Foreign Animal Diseases, published by the U. S. Livestock Sanitary Association.

GLANDERS

CAUSE--Glanders, sometimes called farcy, is caused by a bacterium, Malleomyces mallei.

AFFECTS principally equines (horses, donkeys, and mules) but may spread to dogs, cats, and related species in zoological parks, and to man.

INCIDENCE--Glanders has occurred nearly all over the world. Few if any diseases have a more ancient recorded history. It was recognized by Hippocrates as early as 450 B.C., and described with considerable accuracy by Apsyrtus, the Greek veterinarian of Constantine the Great. Down through history to World War I, the disease has made its greatest devastation among horse stock gathered for war purposes. During World War I more than 58,000 animals in the French Army alone were declared glanderous. World War II, because practically no horses were used in it, was the first major conflict in which glanders did not become epidemic.

According to the best available information, the disease was imported into the United States at the close of the 18th century, and moved westward with the pioneers. There were severe outbreaks among the horses and mules of the United States Army, which is said to have carried the disease into Mexico at the time of the Mexican War in 1846. Any concentration of horses and mules, especially in large cities, was a fertile field for the disease; the common watering trough was one of the means by which it spread. Beginning in 1905 a vigorous program for the control of glanders was initiated in the United States and Canada. As quarantines, sanitary measures, diagnostic methods, and an eradication program developed--and as the horse population declined because of the advance of the combustion engine--the disease gradually waned. Few cases have been reported in the United States since 1924, though the disease is still prevalent in parts of Africa, Asia, and Europe.

SPREAD--Glanders is most commonly spread by nasal discharges contaminating feed and water, which are then consumed by susceptible animals. The organism may also enter the body through skin abrasions or by inhalation.

THE DISEASE--Glanders usually develops about 2 weeks after exposure to infection. The disease may take a chronic or acute course, horses generally having the chronic type and donkeys and mules the acute type. There are three principal manifestations of the disease, which may occur simultaneously or separately: nasal, cutaneous, and pulmonary forms. In the nasal form, firm red nodules appear in the nasal passages. The nodules break open and become ragged-edged ulcers, from which sticky yellowish blood-stained material flows. Upon healing, the scars of these ulcers are radiating or star-shaped. In the cutaneous form there is the appearance of nodules, ulcers, and star-shaped scar tissue in the skin; this form of

the disease is commonly called farcy. The pulmonary form, involving the lungs, is more difficult to detect; it is accompanied by loss of condition, lack of endurance, painful coughing, and a thick mucus discharge from the nostrils. Acute glanders is nearly always fatal. Mortality is not so high with chronic glanders, but a large percentage of animals affected with this type are likely to be carriers of the disease.

TREATMENT AND CONTROL--No medicinal treatment has been found that cures glanders, no vaccine has been developed that provides immunity against it, and animals that recover are susceptible to later infection. The only feasible way to handle the disease is to find and destroy the infected animals. The mallein test was perfected by the Department of Agriculture, and the States began their campaign against glanders in 1905. Mallein is the sterilized, concentrated, and filtered fluid in which the organism causing glanders has been grown.

Animals reacting positively to the test are promptly slaughtered and their carcasses burned or deeply buried. Premises and gear, including watering troughs, pails, mangers, stalls, barn lots, saddles, harness, and grooming tools, must then be thoroughly cleaned and disinfected. Feed and bedding that have been exposed must be burned.

FEDERAL AND STATE RESPONSIBILITIES--In the course of the campaign against glanders, many States passed laws and regulations requiring the prompt reporting, quarantine, and testing of suspected cases and the payment of indemnities for animals destroyed. The Federal Government shared in this program. Many States still have laws making it illegal to treat a case of glanders.

The Federal Government has the responsibility of preventing the entry of glanders from other countries. Horses imported into this country are required to pass a negative test for glanders before they are allowed to enter the United States.

PUBLIC HEALTH ASPECTS--Up to the time of sulfa drugs, glanders in man was a very painful and loathsome disease from which few people recovered. The disease occurs most often through occupational contact with horses or with the infective agent, although it is known to have passed occasionally from person to person. The disease begins with fever, fatigue, loss of appetite, jaundice, headache, and rheumatic pains in the legs; further development brings nodular eruptions on the skin of the face and hands. There are nasal involvement similar to that in the horse, swelling of certain glands, ulceration and draining of the eruptions, a form of pneumonia, diarrhea, emaciation, and usually fatal collapse. The use of sulfadiazene was found successful in treating one reported case in 1946.

PUBLIC RELATIONS ASPECTS--Should glanders appear again in animals of the United States, the knowledge that it is also a dangerous human disease will have a bearing on the public's attitude toward it. A plain presentation of the facts should result in public support of a program to promptly eradicate the disease.

FOR FURTHER INFORMATION--The Department of Agriculture has no separate publication on glanders. The subject is treated in Diseases of the Horse, published by the Department of Agriculture and in standard veterinary texts. State and Federal veterinarians in a region where it appears can provide information on the disease, its occurrence, and measures being taken against it.

HOG CHOLERA

CAUSE--Hog cholera is caused by a filtrable virus, which is present in the flesh, bones, blood, urine, feces, and secretions of the eyes and nose of infected swine.

AFFECTS only hogs, but there may be inapparent carriers of the virus that have not yet been recognized.

INCIDENCE--Hog cholera is found in practically all parts of the world, and has spread to every State in the United States. It is most prevalent in the Middle West and South, where hogs are raised in greatest numbers.

SPREAD--A hog affected with cholera is the most likely means of spreading the disease. It can also be transmitted by the manure, bedding, and litter of hogs in transit, by feet and wheels entering infected places, by streams passing through infected farms, by farmers exchanging labor, by buyers going from premise to premise, by dogs carrying parts of infected carcasses to clean premises, and especially by feeding raw garbage containing infected pork scraps to hogs.

THE DISEASE--Hog cholera is the most serious disease of swine, destroying more hogs than all other diseases combined. If it appears in acute form, hogs sicken and die quickly. If it is less severe, they may be sick for weeks before they die. Incubation period of the disease ranges from 3 to 7 days. Affected hogs at first show a tendency to remain in the nest and not come out to feed. When driven out, their backs may be arched and they shiver and appear to be cold. Later in the course of the disease they become gaunt, tucked up in the flank, and have a staggering gait, with a noticeable weakness of the hind legs. In the early stages, the animals run a temperature of 104° to 107° F., or more, and in the advanced stages have reddish or purplish blotches on the ears, belly, and inner surfaces of the legs. Characteristic symptoms found on post mortem are small red spots on the pharynx, lungs, heart, kidneys, bladder, and large and small intestines, depending on the stage and acuteness of the disease.

However, all symptoms are not uniformly present, and diagnosis is difficult, even for a trained veterinarian. Hog cholera may be confused with swine influenza, anthrax, necrotic enteritis, pneumonia, swine erysipelas, and certain other diseases.

TREATMENT AND CONTROL--When hog cholera is suspected, the owner should call a veterinarian at once to diagnose the disease. If cholera is present, hogs in an advanced stage of the disease should be destroyed. Animals that die or are slaughtered should be burned to ashes or buried under 4 feet of earth and covered with quicklime. Manure should be removed from infected pens and spread on fields or put in piles where hogs

cannot get to it. Litter and rubbish should be burned. Hogs should be kept away from old strawstacks. After a thorough cleaning, the walls, floors, and other surfaces on the premises should be sprayed with a 2-percent lye solution (1 lb. of lye to 5 1/2 gals. water). Dogs on infected and nearby premises should be tied or confined. Raw garbage or table scraps containing meat or bone should be boiled 30 minutes before being fed to hogs. Newly purchased animals should be vaccinated and quarantined from the other hogs for at least 3 weeks, and footwear of farmers and their visitors should be disinfected to avoid carrying the disease from one pen to another and from one farm to another.

No drug or combination of drugs can be regarded as a cure of or treatment for hog cholera. However, there are numerous ways of immunizing against the disease: Four kinds of immunization are used--anti-hog-cholera serum alone, virulent virus administered with this serum, killed virus vaccine (one kind of which is crystal-violet vaccine, which was developed by the former Bureau of Animal Industry and made available through a public patent), and modified live-virus vaccines, used with or without the serum as recommended by the manufacturer. The use of these vaccine materials can be varied to suit the situation. The method of administering the vaccine, the size of dosage, revaccinations, the age and condition of the animals, the immunity status of the pigs' dams, and the ability of the pig to develop immunity must all be taken into account. It has been definitely shown that there is a marked difference in the immunity obtained with the same product in herds of pigs at different farms. Livestock sanitary officials and practicing veterinarians may vary their handling of immunization in many ways to meet the needs of animals and herds.

FEDERAL AND STATE RESPONSIBILITIES--Agricultural Research Service regulations prohibit interstate movement of swine affected with hog cholera. Hogs not immunized against cholera under Federal supervision may be moved interstate from public stockyards only for immediate slaughter.

When cholera-infected hogs are presented for slaughter at a packing house, Federal meat inspectors mark them "U. S. condemned," and the carcasses are made into tankage.

In Canada and Great Britain, hog cholera is eradicated wherever it appears.

State regulations on hog cholera vary. Many States have educational programs, some exercise control at livestock auctions and other central points, some have laws or regulations governing control methods.

PUBLIC HEALTH ASPECTS--No case has ever been reported of hog cholera in man.

PUBLIC RELATIONS ASPECTS--Routine reporting is indicated. Considering the ability of hog cholera to kill animals, the disease creates less public reaction than might be expected. The reporter should familiarize himself with State laws and regulations and with local vaccination practices.

FOR FURTHER INFORMATION--Farmers' Bulletin 834, Hog Cholera, gives information on the disease in compact form. A motion picture film, Hog Cholera--African Swine Fever--A Comparison, is scheduled for release by the U.S. Department of Agriculture in 1956. For local information consult the State veterinarian or other livestock sanitary officials.

HYPERKERATOSIS (X-DISEASE)

CAUSE--Hyperkeratosis or "horny-skin disease," originally called X-disease because its origin was unknown, occurs in cattle when they consume relatively small amounts of highly chlorinated naphthalene, a synthetic wax. Chlorinated naphthalene is one of three groups of "extreme pressure agents" added to lubricants to prevent their deterioration when used under extremes of heat and pressure. The other two have not been found to cause X-disease--at least in the amounts to which cattle are normally exposed in the field. One of the commonest ways for this damaging additive to reach livestock is in pelleted feeds. Pelleting machines used to compress cattle feeds are lubricated in such a way that some of the grease gets into the pellets. If the lubricant contains highly chlorinated naphthalene, animals eating the pellets get X-disease. Pellets are perfectly safe, however, so far as X-disease is concerned, if this toxic chemical is not used in the lubricant.

AFFECTS only cattle.

INCIDENCE--Following its first appearance in New York State in 1941, the disease is definitely known to have occurred in 35 States. It also turned up in Germany in 1946-48.

SPREAD--X-disease occurs most often when animals lick or otherwise consume lubricants containing highly chlorinated naphthalene. Application to the skin of mixtures containing highly chlorinated naphthalene is also a cause. The disease cannot be transmitted from one animal to another.

THE DISEASE--Watery discharge from the eyes and nose and frequent licking of the nostrils are among the first symptoms. Drooling is caused by wartlike growths that appear on the tongue, dental pad, and cheek. As the disease progresses, there are loss of condition, poor appetite, depression and stupidity, and a progressive thickening of the skin, which wrinkles into heavy folds over the withers, on the sides of the neck, on the cheeks, and behind the shoulders. Vitamin-A content of the blood becomes extremely low. Internal organs, including the gall bladder, liver, pancreas, and kidneys are affected, and abortion and mastitis in cows may result. Diarrhea occurs, usually late in the course of the disease, as the animal becomes weak, emaciated, and finally dies. Symptoms and lesions vary greatly, depending on the amount of chlorinated naphthalene the animal has taken. Skin hyperkeratosis may develop in 6 weeks to 2 months, or even longer. Deaths from hyperkeratosis may run as high as 75 to 80 percent in young calves, from 50 to 60 percent in older calves, and from 10 to 35 percent in adult cattle.

TREATMENT AND CONTROL--No treatment has been found that has any value as a cure or palliative for hyperkeratosis as long as the animals

continue to obtain the toxic substance. Early diagnosis is highly important in order that access to highly chlorinated naphthalene can be stopped. If this action is taken while the affected animals still have an appetite and before secondary infections develop, many of them recover with ordinary good care. Prevention, however, is the best cure. The following steps are recommended to prevent occurrence of the disease:

1. Keep cattle away from machinery so that they cannot lick or come into contact with oil and grease that might contain highly chlorinated naphthalene.
2. Fence off drain pits for oil or places where crankcase oil is dumped.
3. If pelleted feeds are used, insist on seeing a copy of the warranty furnished by the oil company to the manufacturer of the pellets that the lubricant used in the pelleting machinery contained no highly chlorinated naphthalene.
4. If used motor oil is used in devices against which cattle rub to oil themselves, care should be taken not to use "break-in" oil from new motors or oil from vehicles in which an upper cylinder lubricant has been added to the gasoline.

Should the disease appear in spite of these precautions, the livestock owner is faced with the question of what to do with his affected animals. If for various reasons he does not desire to sell them for slaughter, he may keep them with reasonable hope of complete recovery, provided they are still eating, have no elevation of temperature, and show no evidence of secondary infection.

FEDERAL AND STATE RESPONSIBILITIES--The Federal Government has cooperated with 18 States--Alabama, Colorado, Connecticut, Georgia, Illinois, Indiana, Kansas, Michigan, Montana, Nebraska, New Jersey, New York, North Dakota, Pennsylvania, Tennessee, Texas, Virginia, and Wisconsin--in a program of research to find the cause of X-disease. Both the Federal Government and the cooperating States have issued information about this industrially caused disease. Manufacturers of feed concentrates and lubricants are cooperating in the effort to keep the toxic material away from livestock.

PUBLIC HEALTH ASPECTS--None are known.

PUBLIC RELATIONS ASPECTS--Appearance of hyperkeratosis in a community can cause great apprehension among livestock owners who have no knowledge of the disease. Information channels can provide a useful public service by giving the facts about its cause and the simple measures required to stop its further occurrence. Since some of the early symptoms are similar to those of foot-and-mouth disease, the public mind can be relieved by learning the true nature of the disease.

FOR FURTHER INFORMATION--State and local veterinarians and Federal veterinarians in charge of State offices generally have the facts about X-disease. U. S. Department of Agriculture Leaflet No. 355, Hyperkeratosis (X-disease) of Cattle, treats this subject. Research is continuing, to investigate other possible causes of the disease and to examine the possibilities of treatment. Further information may be obtained from the Agricultural Research Service, U.S. Department of Agriculture, Washington 25, D. C.

INFECTIOUS ANEMIA

CAUSE--Infectious anemia, or swamp fever, is caused by a filtrable virus. Ten strains of the virus have been studied from different areas of the United States. The virulence of the organism varies, and it shows considerable resistance to heat, freezing, drying, and disinfectants.

AFFECTS horses, mules, and donkeys.

INCIDENCE--The disease has worldwide distribution. In the United States, since 1903, it has been reported in more than three-fourths of the States. Because of the difficulties of diagnosis, however, it was probably more widespread than the reports indicate. The disease was once very common among mules of the Mississippi Delta, but the problem is now less serious because a great many mules have been displaced by tractors. Mechanization of the cavalry has removed the old threat to Army horses and mules. But the disease is still economically important to establishments where horses are raised, to herds kept by pharmaceutical concerns for the production of serum, and to owners of Thoroughbreds. It is also a distinct threat to any assemblage of horses for races, horse shows, county fairs, and rodeos.

SPREAD--Infectious anemia may be transmitted by biting flies, lice, and mosquitoes; by careless use of hypodermic needles; infected mares may transmit the disease to their offspring; body secretions and excretions may carry the virus, which spreads slowly by long and intimate contact of infected animals with uninfected ones, but the exact method of transmission under natural conditions is still not entirely understood.

THE DISEASE--Infectious anemia may appear in any of three forms--acute, chronic, and inactive--and is very difficult to diagnose. In the acute form the onset is sudden, with temperatures of 105° to 108° F. The animal suffers lack of appetite, depression, and loss of spirit and energy; respiration is accelerated; sweating is profuse in hot weather; the hind feet are often placed well forward under the body; there is rapid loss of body weight; there may be dropsical swellings of the abdomen, legs, and chest; the membranes of the eye may show congestion, followed by yellowish discoloration; urination is frequent; and diarrhea may develop in severe cases. Samples of blood taken during or just after the fever may show anemia, but the blood often returns to normal between attacks of fever. The attack may last 3 to 5 days, after which the animal appears to be well, or it may continue until the animal dies. The disease in the acute stage may be confused with anthrax, influenza, equine encephalomyelitis, and other highly febrile conditions. The incubation stage may vary from 4 to 95 days, but the average is about 2 weeks.

In the chronic form, the attacks are less severe and the intervals between them are longer, but death may ensue during or following an attack.

On the other hand, the attacks may grow less frequent and the animal may become a carrier. In chronic cases there may be increasing evidence of anemia, showing up in pallidness of visible mucous membranes. The pulse is sometimes slow and weak, the heart action is irregular, and the jugular pulse may be visible. Muscular weakness and partial paralysis of the hind quarters may be a symptom. In these cases the disease may be confused with dourine or a heavy infection of strongyles (roundworms parasitic on the alimentary tract and tissues of the horse).

In latent or inactive cases, the animals show no symptoms whatever, but they carry the infection and are a menace to other horses. The Department of Agriculture had a horse that was a proven carrier of infection for more than 18 years.

Diagnosis is so difficult that, although many methods have been tried, none is trustworthy except injecting the blood of an infected animal into a disease-free one.

TREATMENT AND CONTROL--The actions taken during the outbreak of infectious anemia among more than 1,000 race horses in Massachusetts, New Hampshire, and Rhode Island in 1947, the worst in the country's experience, demonstrate the method used to control this disease. The ailment was diagnosed by studying the symptoms, case histories, and the carcasses of animals that died, and by inoculating animals free of the disease. Biting flies apparently spread the disease rapidly. The horses were quarantined for 86 days, sick animals were isolated, temperatures of all horses were taken daily, biting insects were screened out of the stables and combated with DDT, horses were fed and watered from individual containers, bedding and manure were burned, and horses that showed symptoms were slaughtered and their carcasses burned or deeply buried in quicklime. The greatest care was exercised to see that the disease was not spread by unsterilized instruments and tattooing needles, and no equipment, such as saddles, bridles, and spurs, could be used on different animals. It was necessary to use 162 uninfected test horses to find which animals were diseased, and 76 blooded animals died or were slaughtered. The outbreak, which threatened all racing in the country, did not spread and the disease was controlled.

A further means of preventing spread of the disease is to refrain from introducing horses from clean areas into infected areas and, even more important, to avoid introducing horses from infected into clean areas.

No treatment has been found that cures the disease and no vaccine has been devised that prevents it, though research workers have made many attempts to find both.

FEDERAL AND STATE RESPONSIBILITIES--Actual handling of cases of infectious anemia is done by State livestock sanitary officials. Some States, during the New England epidemic, issued regulations prohibiting the entry of diseased animals. The Agricultural Research Service furnishes diagnosticians and technical assistance and advice, and carries out research on this disease. The Federal Government also has regulations prohibiting the movement of diseased animals across State lines. Federal-State cooperation had the desired effect in the New England outbreak--control of the disease.

PUBLIC HEALTH ASPECTS--Man is apparently not very susceptible to the disease, though human cases have been reported in Germany and the Netherlands.

PUBLIC RELATIONS ASPECTS--Prevention remains the best method of handling infectious anemia. Information outlets can do a useful job of pointing out the necessary precautions in advance of any sizable gathering of horses in one place.

FOR FURTHER INFORMATION--State livestock sanitary authorities and Federal veterinarians in charge are always a good source of current information on this disease. Farmers' Bulletin 2088, Infectious Anemia (Swamp Fever) of Horses, Mules, and Donkeys, treats the subject in some detail.

JOHNE'S DISEASE

CAUSE--Johne's disease (pronounced yō'nĕz, named for Dr. Albert Johne, German physician who first investigated the disease in 1895) or paratuberculosis is caused by a small rod-shaped bacillus named Mycobacterium paratuberculosis; it is very similar to the organism that causes tuberculosis.

AFFECTS mainly cattle, occasionally sheep and goats.

INCIDENCE--Johne's disease has been found in many countries of Europe and in parts of Asia. It is widespread in the United States, having been reported in most of the States. Although specific figures are not available for proof, many veterinarians and livestock sanitary authorities believe the disease is spreading and that diagnosis lags far behind occurrence.

SPREAD--It is generally believed that Johne's disease is spread for the most part by the droppings of infected animals. In the course of grazing and eating feed from contaminated ground, other animals, usually calves, which are more susceptible, pick up the infection, which they carry with them into adulthood.

THE DISEASE--Johne's disease has a very long incubation period. The Department of Agriculture, in controlled experiments, found that the shortest incubation period was 13 months. Symptoms usually appear in animals more than 2 years old, often showing up in heifers and cows shortly after calving. Usually the first noticeable evidence is chronic intermittent diarrhea, accompanied or preceded by loss of weight. The animal becomes unthrifty in appearance, exhibiting a rough hair coat, dry skin, and increasing emaciation. The appetite remains good, however, and the temperature and pulse are normal. Milk production is greatly reduced when symptoms appear. Infected animals continue to scour and waste away, and very often die. Internally, the germs attack only parts of the intestines and adjacent lymph nodes.

Since the disease is easily confused with the effects of internal parasites or malnutrition, diagnosis is often difficult. The use of johnin as a diagnostic test is helpful in diagnosing infection in animals that may have the disease and be spreading it but show no apparent symptoms. Johnin, made in the same way as tuberculin, is used for the test, and is injected into the skin. A positive reaction is a thickening of the skin 48 hours later at the point of injection. Before such a skin test can be regarded as conclusive, however, the Johne's disease organism should be demonstrated in stained smears of mucous membrane.

The Department of Agriculture has a continuing research program on Johne's disease.

TREATMENT AND CONTROL--No satisfactory treatment, even among the antibiotics, has been found for this disease. Vaccines were tried by the Department of Agriculture, but the experiments had to be abandoned when it was found that vaccinated animals sometimes reacted to the tuberculin test, thus complicating measures being taken against bovine tuberculosis.

When a herd is tested for Johne's disease, and the number of reactors is small, all the reactors should be removed at once and slaughtered. The owner is faced with a more difficult decision if the number of reactors is large. He may then decide to remove only those showing symptoms and to dispose of the remaining reactors by slaughter as young stock is raised for replacement. The risk in this procedure is that the reactors may spread the disease, even though they show no symptoms.

Immediately after removal of infected animals, the mangers, pens, troughs, walls, and floors should be cleaned and disinfected with a 4-percent solution of cresylic disinfectant (1 cup to 2 gallons of water). Feed and water containers must be protected from cattle droppings. Stagnant water holes should be fenced off or drained. In lots used by infected animals, all manure and 4 inches of topsoil should be removed and spread on fields to which cattle have no access. Young calves should be reared in quarters not used by infected animals. Cattle showing ill health should be isolated and tested; if it is Johne's disease they should be slaughtered at once. Suspected herds should be tested with johnin every 6 months; if no reactors appear after 18 months of testing, the herd is probably free of the disease. Livestock owners should take every precaution to keep their herds free from this ailment; replacements should be purchased only from herds free of the disease.

FEDERAL AND STATE RESPONSIBILITIES--Since 1927, the U. S. Department of Agriculture has had the authority to cooperate with the States in the payment of indemnities following slaughter of positive reactors to the johnin test. Federal indemnities are paid on a 50-50 basis with State governments, but not to exceed $25 per head of grade cattle and $50 per head of purebred cattle, and not to exceed one-third of the difference between appraised and salvage values. Since few States absolutely require the slaughter of all infected animals, no area eradication plan is at present feasible. However, State and Federal disease control officials are available to assist in the control of Johne's disease in individual herds.

PUBLIC HEALTH ASPECTS--The disease has not been reported in man and apparently presents no public health problem.

PUBLIC RELATIONS ASPECTS--Johne's disease does not announce itself suddenly and dramatically; nevertheless it is a killer. Spreading slowly through a herd from year to year, it can cause heavy losses in a few years. Livestock owners should be warned of the insidious character of the disease, and advised to take steps against it. Information on the disease in a given area can be obtained from officials associated with animal disease eradication programs, who are in a position to cooperate with owners of herds affected with Johne's disease.

FOR FURTHER INFORMATION--State and Federal authorities of animal

disease eradication programs are the best local source of information on the incidence of Johne's disease and the steps being taken to eradicate it. Department of Agriculture Circular 873, Johne's Disease (Paratuberculosis) of Cattle, is for sale by the Superintendent of Documents, Government Printing Office, at 10¢ a copy.

LARYNGOTRACHEITIS (INFLUENZA)

CAUSE--Laryngotracheitis, an inflammation of the larynx (voice box) and trachea (windpipe), is caused by a filtrable virus.

AFFECTS only chickens and pheasants. The disease is rarely observed in young chicks, although they are susceptible to the virus. Turkeys, ducks, pigeons, and guinea fowl cannot be infected.

INCIDENCE--The disease has been found in all parts of the United States and in Australia, Canada, England, Germany, and Hawaii.

SPREAD--The virus is spread by discharge from the respiratory system of affected or carrier birds. Indirectly, it may be carried from one farmyard to the next by poultry buyers, men delivering feed, and others. It may be spread by feed bags that have not been disinfected before reuse.

THE DISEASE--The onset of laryngotracheitis is sudden. The outstanding symptom is gasping. The bird stretches out its head with beak open to get its breath, then droops its head and closes its beak to exhale. These motions are repeated with each breath, and are often accompanied by coughing, shaking the head, rattling, wheezing, and sometimes loud cries. The breathing noises are caused by partial obstruction of the respiratory passage by discharges of bloodstained mucus and pus. These discharges may build up in the air passages until they are stopped up and the bird dies of suffocation. Frequently the walls of a poultry house are bloodstained as a result of chickens coughing up bloody discharge.

Following natural exposure, the incubation period varies from 6 to 12 days. The average course of the disease in a flock is about 2 weeks, but it may occasionally last twice as long. Death losses may vary from few or none in young chicks during warm weather to 70 percent among heavy birds during cold weather; the average year-round loss is about 15 percent. In addition to death losses, egg production is depressed for 2 to 4 weeks in proportion to the severity of the disease.

In mild cases, the symptoms are indistinguishable from those of coryza (roup). A poultry diagnostic laboratory is best equipped to differentiate this disease from other respiratory ailments of poultry.

TREATMENT AND CONTROL--No satisfactory flock treatment is known for this disease. A vaccine is used in flocks that have had the disease before or if the disease is dangerously prevalent in the vicinity. It is not recommended if prevention by isolation is possible, because it involves the use of live virus, which when improperly used may cause an outbreak of the disease. When an outbreak occurs, all unaffected birds should be immediately vaccinated. Before introducing new stock to the premises,

it is best to depopulate the pens and houses completely and let the area remain vacant for at least a month. Clothing and footwear used around the diseased flock should be laundered or disinfected before they are worn in the presence of other chickens. New stock should come only from flocks known to be free of the disease or from eggs already produced (there is no evidence that the virus is carried from hen to chick through the egg). Visitors from contaminated localities, hucksters, dogs, etc., should be kept away from the reconstituted flock.

FEDERAL AND STATE RESPONSIBILITIES--There is no Federal program for the control of laryngotracheitis.

PUBLIC HEALTH ASPECTS--There are no reported cases of the disease being transmitted to man.

PUBLIC RELATIONS ASPECTS--In some areas, eradication is recommended. In others, particularly those with heavy poultry population, this may not be feasible, and vaccination may be the recommended procedure. State poultry disease authorities can indicate the direction to be taken under the circumstances.

FOR FURTHER INFORMATION--State poultry disease authorities are the best source of information on local occurrence of this disease and methods of handling it. There is a short description of the ailment in Farmers' Bulletin 1652, Diseases and Parasites of Poultry. An exhaustive discussion of the disease is given in Diseases of Poultry, published by the Iowa State College Press, Ames, Iowa.

LEPTOSPIROSIS

CAUSE--Leptospirosis is caused by a spirochete (a slender, spiral bacteria) called Leptospira. About 40 species of Leptospirae have been described in various parts of the world. In this country, cattle having the disease are usually infected with Leptospira pomona; swine with L. pomona and L. canicola; horses with L. pomona; dogs with L. canicola and L. icterohaemorrhagiae; and rats largely with L. icterohaemorrhagiae.

AFFECTS principally cattle, swine, horses, dogs, rats, and man. The infection has been tentatively diagnosed in sheep and goats. Wild animals other than rats may be affected.

INCIDENCE--Leptospirosis occurs in all parts of the world. There is considerable confusion about the exact incidence in the United States because (1) sometimes symptoms resemble other diseases in both animals and man; (2) so little has been known about the disease that veterinarians, physicians, and technicians have had little or no opportunity to study the disease in the course of formal education, and serological surveys have been limited; and (3) many cases show no visible symptoms and cannot be recognized without laboratory tests.

The disease has been diagnosed in cattle in 40 States and in swine in 10 States. Although limited surveys have been made, the incidence of leptospirosis in cattle and hogs in this country is not known. The disease has also been found in horses and dogs.

SPREAD--Leptospirosis is usually spread from animal to animal in a herd through contact with infected urine. The Leptospirae enter the body usually through the skin or the mucous membranes.

THE DISEASE--In classical symptoms, Leptospirae attack the blood stream first, causing fever. By the end of the first week they attack the kidneys, and the urine may continue to contain the disease organism for several months or even years. The Leptospirae may also attack other organs of the body, principally the liver, causing jaundice. When the organisms leave the blood stream to attack other organs, the temperature drops. The effects of the disease may be so mild that it is not apparent, or it may run a typical course characterized by recognizable symptoms. However, all typical symptoms do not necessarily appear in all cases of leptospirosis. The disease appears to be self-limiting in most animals other than dogs and rats.

The incubation period in cattle after artificial exposure is about 10 days. First symptoms are normally a rise in temperature and loss of appetite and weight. The urine may be dark red or wine colored. Milk production drops, and the cow may give yellow-colored milk with occasional blood clots. Abortions may occur when pregnant animals are infected,

which sometimes causes confusion of diagnosis with brucellosis. Sometimes jaundice develops. The disease may run a course of from 3 to 10 days. Experience in this country shows that 1 of 20 infected cows may die and up to one-third of infected calves.

General symptoms in swine may be no more severe than a mild digestive disturbance. But there may also be a state of excitement followed by convulsions, excessive salivation, stiffness of the neck, and signs of meningitis. Pregnant sows may abort. Animal disease authorities now believe leptospirosis is more prevalent among swine in this country than has been considered heretofore. However, confirmed swine losses from the disease have been light.

TREATMENT AND CONTROL--Most investigators agree that there is still no reliable treatment for leptospirosis. A Leptospira bacterin is on the market, but its value has not been definitely proved. During the febrile stage of the disease some success has been reported from treating the infected animal with antibiotics. However, once the disease organism leaves the blood stream and lodges in various organs of the body, accompanied by the drop in temperature, such treatment is questionable.

A serological test is available, which can be useful in diagnosis, in surveys of the incidence of the disease, and in epidemiological studies. It can also be used to identify carriers.

Complete eradication appears to be impractical at this time. Precautions that can be taken to prevent spread of the disease include the use of recognized sanitary measures: (1) Isolate sick animals, (2) don't feed milk from infected cows to calves, swine, or chickens, (3) bury or burn carcasses of animals that die, (4) bury or burn fetuses and the bedding of sick animals, (5) don't buy herd replacements until at least 3 months after the last case of leptospirosis has been eradicated, and (6) control rats and other rodents.

FEDERAL AND STATE RESPONSIBILITIES--There is no Federal-State program for the control or eradication of leptospirosis. Some States are testing blood samples from animals suspected of having leptospirosis, to aid in diagnosis and in making surveys of the incidence of the disease.

PUBLIC HEALTH ASPECTS--Latest available figures show that only about 30 human cases a year have been reported to the U. S. Public Health Service. At least 14 States do not require reporting of this disease. Furthermore, leptospirosis can be easily confused with such diseases as influenza, hepatitis, yellow fever, brucellosis, and meningitis. Therefore, it may be safe to say that many cases are either not diagnosed or not reported.

Infection in man occurs either directly from the urine or tissues of an infected animal or indirectly through contact with water or soil contaminated by infected animals. Leptospirosis is normally an occupational disease of people who are in frequent contact with animals or their products. It can be contracted from rats, mice, cattle, swine, or dogs. Spread of the infection from man to man is highly unlikely.

Leptospirosis can range from a mild illness resembling influenza to a very serious disease resulting in death. The severity of the illness

depends upon the size of the infecting dose and the species of Leptospirae. The disease in man has been called Weil's disease (contracted from rats), canicola fever (contracted from dogs), swineherd's disease (contracted from swine), autumn fever or Fort Bragg fever (probably contracted from field mice).

PUBLIC RELATIONS ASPECTS--Information outlets can perform a public service by informing the public about the importance of leptospirosis in the United States. Facts should be presented to livestock owners and the general public to help them prevent the spread of the disease with the best weapons available.

FOR FURTHER INFORMATION--The Department has no published material about this disease, but questions may be directed to the Agricultural Research Service, U. S. Department of Agriculture, Washington 25, D. C.

LYMPHOMATOSIS

CAUSE--Lymphomatosis is caused by a filtrable virus. Although the virus has not yet been isolated, the disease has been transmitted to chicks by inoculating them with filtered extracts of blood, tissues, and secretions or excretions from infected birds. There are three known types of lymphomatosis: Neural--attacking the nerves; visceral--attacking the internal organs; and ocular--attacking the eyes. There are also several related diseases. One, called osteopetrosis or marble bone, causes enlargement and hardening of the long bones. Another affects the blood-cell-forming tissues in the bone marrow. A number of leukemic forms attack the red and white corpuscles. All these conditions, together, are called the "avian-leukosis complex." A bird may be affected by one or more of these types at the same time. Whether they are all caused by a single virus is not yet known. The fact that investigators at one laboratory often cannot verify results at another suggests they may be dealing with different viruses.

AFFECTS chickens primarily. The disease has been reported also in turkeys, guinea fowl, pheasants, and various ornamental birds. Transmission from one species to another seems to occur rarely, if ever.

INCIDENCE--Lymphomatosis has become so widespread in the poultry population that there are probably few disease-free flocks in the United States or in any major poultry-producing country. Lymphomatosis is a penalty of progress. Although it probably existed far back in antiquity, it caused little trouble until the poultry industry began to use modern production methods. Forced-draft incubators, mass brooding, and interstate shipments of chicks were ideal for spreading the disease.

SPREAD--Lymphomatosis can be spread through the egg from hen to chick, directly from bird to bird, or indirectly through the air or by caretakers, feed, equipment, insects, rodents, and possibly vaccination. Clinically normal birds can carry the disease and transmit it through the egg or through body secretions or excretions.

THE DISEASE--Lymphomatosis is an infectious, contagious disease which becomes malignant if a tumor develops as a result of the infection. Because the disease may affect any organ or tissue of the chicken's body, the symptoms are extremely varied. However, the following forms are most commonly seen:

1. Neural (fowl paralysis, range paralysis). This form of the disease can affect any part of the nervous system of the chicken. Among the most common symptoms are partial or complete paralysis of the legs or wings. The affected bird can be easily identified in the flock because of its unsteady gait or inability to walk, or because of obvious drooping of one or both wings. Other, less striking

symptoms are respiratory distress (gasping) not associated with a discharge from the nose or mouth, pendulous crop, and diarrhea. Post-mortem examination shows that some of the nerves are enlarged, are discolored a tannish gray to brown, and have lost their normal markings.

2. Visceral (big liver disease). The visceral form is the most common form of the disease but is quite difficult to detect in the flock. The symptoms are somewhat indefinite and might result from a number of causes. Pale or bluish comb and wattles in nonlaying birds, general weakness and emaciation, or excessive accumulations of fecal material and urates may indicate this form of the disease. After death, any of the viscera or muscles or the skin may show localized or diffuse tumors, but the most common characteristic is an enlarged or tumorous liver.

3. Ocular (iritis, pearly eye, gray eye). In this form the eyes become gray because of loss of color in the iris, and the eyeballs become bulging or fishy. Irregularities and distortions of the pupil are often present in birds having this form, and the pupil does not dilate upon death as it does in healthy chickens.

One of the confusing peculiarities of lymphomatosis is its long and variable incubation period. When a population of birds is exposed or inoculated during the first few days of life, some die of the disease within 40 to 50 days, the death rate then increases until a peak is reached between 150 and 200 days, and after that a few birds continue to die of the disease as long as the group is held, even up to 5 years.

Annual losses to the poultry industry from this disease average about $65 million--half of the total loss from all poultry diseases. Some flocks are hit harder than others; none are immune. Deaths range from 5 to 50 percent. The fact that the disease usually does not appear to a great extent in flocks until after the expense of rearing has been incurred accounts partly for the great financial toll.

TREATMENT AND CONTROL--Attempts thus far to prevent or treat lymphomatosis with drugs, vitamins, hormones, and antibiotics have failed. Experiments with vaccine for the visceral form show promise but the vaccine has not yet been developed to the point of practical use. A serological test that would detect the visceral type in clinically normal chickens has passed early research stages but needs further investigation under a variety of conditions. Such a test would be invaluable in finding carrier birds so that they could be removed from a flock, thus eliminating transmission of the disease through the egg. The only methods now practical for reducing the incidence of lymphomatosis in a poultry flock are (1) breeding for resistance and (2) hatching and brooding chicks in isolation by family or source groups for the first month to prevent contact transmission. Breeding for resistance has been only partially successful: the most resistant birds still show about 10 percent lymphomatosis over a period of 600 days. Experiments show that fewer cases develop in chicks exposed after 30 days than among those exposed earlier, indicating that resistance to the disease increases with age. Hatching and brooding chicks in isolation is not practical, however, for most poultrymen. Until more knowledge is produced through research, poultry raisers must rely on good management and sanitation to reduce the chance of exposure to

disease agents, and use breeding hens from families showing high livability or from hens that have produced progeny with high livability.

FEDERAL AND STATE RESPONSIBILITIES--By the late thirties, lymphomatosis had become so widespread and destructive that scientists and farmers in the big poultry-producing States asked the U. S. Department of Agriculture to take the lead in an all-out attack on the disease. The Department responded in 1939 by establishing the Regional Poultry Research Laboratory at East Lansing, Mich., in cooperation with 25 State experiment stations--Connecticut, Delaware, Illinois, Indiana, Iowa, Kansas, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, New Hampshire, New Jersey, New York, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Dakota, Vermont, Wisconsin, and West Virginia. In this research program, the Laboratory staff and experiment station workers have collaborated in the investigation of ways and means to control lymphomatosis. Although these investigations have added materially to information on the disease, adequate means of control are not yet known. This situation may be attributed in part to the insidious nature of the disease and in part to the complexities of the problem. There are no specific Federal or State regulations relating to the movement of lymphomatosis-infected chickens.

PUBLIC HEALTH ASPECTS--There are no recorded cases of this disease having been transmitted to man.

PUBLIC RELATIONS ASPECTS--Until research has found practical ways of controlling or preventing lymphomatosis, there is no recourse but to live with the disease. The result, however, is too often one of acceptance. Public information sources can do a real service to the poultry industry by occasionally calling attention to the widespread incidence of lymphomatosis and the serious economic losses caused by it. These stories are particularly effective at times when new research findings are announced.

FOR FURTHER INFORMATION--The subject is discussed in Farmers' Bulletin 1652, Diseases and Parasites of Poultry. Miscellaneous Publication 609, Poultry Disease Investigations at the U. S. Regional Poultry Research Laboratory (for sale only), discusses the early research being conducted on lymphomatosis at the Laboratory.

General information on the disease nationally and on research being conducted may be obtained from the U. S. Department of Agriculture. State and local veterinarians, extension poultry specialists, and county agricultural agents are good sources of information about the disease locally.

MALIGNANT EDEMA

CAUSE--Malignant edema is caused by Clostridium septicum and closely related bacteria--spore-bearing organisms that develop in the absence of air. Spores of this microorganism are very common in the soil and in the intestinal tracts of herbivorous animals.

AFFECTS principally horses, cattle, sheep, and hogs. May also affect man.

INCIDENCE--Malignant edema organisms have been found in the upper layers of the soil wherever animal diseases have been studied. Neither climate nor type of soil seems to limit its occurrence.

SPREAD--The spores of malignant edema are often widespread in farm or garden soil and may be picked up from street dust, hay dust, animal feces, decomposing organic matter, and other sources. The organism may enter the body through the mucous membranes of the mouth, throat, or genital passages. It may also be carried into deep wounds or be introduced into the animal body through unhygienic surgery, castration, vaccination, or delivery of young.

THE DISEASE--Malignant edema is an acute inflammatory disease of domestic and wild animals, resulting from the introduction of Cl. septicum into the deep connective tissues. The first symptoms are usually overlooked. The animal appears listless and disinclined to move about, and lies down in shady and quiet places. If it is forced to move, its hind legs are drawn forward with a peculiar stiff, dragging movement. As the disease develops, breathing becomes fast and painful, characterized by frequent spasmodic jerks. The pulse is quick and the temperature rises to 106° or 107° F. A doughy and painful swelling appears at the point of infection, which spreads more and more. The disease develops rapidly, resulting in coma and death, in many instances in 24 to 48 hours.

Unlike blackleg, malignant edema rarely appears as an epidemic but is more common as isolated cases. The inflammatory swellings are dark red and contain moist gelatinous material under the skin and in the intermuscular connective tissue. Blackleg and malignant edema can be differentiated by inoculating guinea pigs, rabbits, and pigeons. Malignant edema kills all three of these species, but blackleg kills only guinea pigs. Bacteriological cultures may also differentiate between them.

TREATMENT AND CONTROL--Because of the retiring behavior of animals in the first stages of malignant edema and because of its swift onset and rapidly fatal termination, the disease is usually so far advanced when found that medicinal treatment is without avail. If caught in time, massive doses of some of the antibiotics might be helpful. However, the

best cure for malignant edema is to prevent it. A combined Clostridium chauvei-septicum bacterin for simultaneous immunization against blackleg and malignant edema, given in 5-cc. doses, is popular in blackleg areas; it has been found that the two organisms often appear together in infected animals and that malignant edema is more common in blackleg areas. It is customary to administer this bacterin in the spring of the year, or, in range country, at the time of the fall roundup. Animals to be shipped may be given a trivalent bacterin, which protects against blackleg, malignant edema, and shipping fever. This bacterin, however, must be given in 10-cc. doses and may be too severe for calves that are being branded, dehorned, castrated, and vaccinated in preparation for shipping. It should be given not less than 2 weeks before shipment in order to provide protection during shipment.

An animal dead of malignant edema should be burned or deeply buried in quicklime, followed by thorough cleaning and disinfection of sheds, barns, and other premises occupied by the diseased animal. Recommended disinfectant is a 5-percent hot lye solution, made by dissolving 5 cans of lye in 10 gallons of hot water.

FEDERAL AND STATE RESPONSIBILITIES--Federal regulations prohibit the movement of diseased livestock across State lines but, since malignant edema is so rapidly fatal, a case of it is seldom found in interstate transportation of animals. Although both Federal and State livestock sanitary officials have an active interest in all diseases of livestock, preventive action and coping with actual cases of malignant edema are left to the lifestock owner and the veterinary practitioner.

PUBLIC HEALTH ASPECTS--Since the advent of aseptic surgery and antibiotics, malignant edema is by no means the problem to human health that it once was. During World War I Cl. welchii was the principal cause of gas gangrene but was often associated with Cl. septicum and other anaerobes (organisms that develop in the absence of air). Because of the many advances in human medicine, it caused little trouble during World War II and seldom occurs in civilian life.

PUBLIC RELATIONS ASPECTS--Malignant edema is known and accepted as a hazard to the health of livestock, particularly in blackleg areas, and animals are immunized against it. A spring (or fall roundup) reminder, together with the salient facts about the disease, is appropriate through the various information channels.

FOR FURTHER INFORMATION--State livestock sanitary officials and Federal veterinarians in charge are the best source of information on this disease in the various States. A summary on the disease appears in the U. S. Department of Agriculture publication, Diseases of Cattle.

MASTITIS

CAUSE--Mastitis, or inflammation of the udder, is caused by a variety of organisms. Streptococci, of which there are several species, and staphylococci are the principal cause, although various other bacteria and yeasts can also induce the disease. Mastitis in a herd, in a single cow, or even in different quarters of the udder of the same cow can result from more than one kind of infectious agent.

AFFECTS dairy cows, beef cows, and female goats and sheep. In the United States it is of primary importance in the dairy cow. Losses from the disease are estimated by the U. S. Department of Agriculture at $225 million a year.

INCIDENCE--Very widespread in the United States and other countries. It is rare, indeed, to find a large herd that has not had trouble with mastitis at some time.

SPREAD--In the dairy cow, the organisms that cause mastitis are usually spread from the teats of diseased cows to those of healthy cows by the hands of milkers or by the teat cups of milking machines. The disease can also be disseminated by flies or by contact with contaminated floors or bedding. Conditions that may favor bacterial invasion and the development of mastitis include exposure of the udder to cold or wet weather; sudden changes in temperature; blows, kicks, bruises, or abrasions of the udder; wounds on the teats; infrequent, irregular, or incomplete milking; introduction of contaminated foreign bodies, such as milk tubes, straws, and teat plugs, into the teat canal; or any systemic disturbance of the animal's health.

THE DISEASE--In most instances, bacteria enter the opening of the teat, pass up the teat canal, and establish themselves in the milk cistern, which is in the lower part of the quarter of the udder. Depending upon circumstances, the bacteria may spread slowly or rapidly to other parts of the quarter.

Acute mastitis, commonly known as garget, is easily recognized by the livestock owner. The udder becomes feverish, tense, very hard and tender to the touch, and the animal moves reluctantly because of the pain. Milk secretion is largely or entirely suspended. Such milk as the cow gives is lumpy or stringy, in some cases appearing straw-colored, occasionally tinged with blood, and containing yellow clots. Acute mastitis can result in abscesses, atrophy of a quarter of the udder, gangrene, and, occasionally, in the death of the animal. Following proper treatment the cow may apparently recover and the milk appear normal, though production may not return to its previous level. However, the bacteria may remain in the udder and produce further attacks. A veterinarian should be called when acute abnormal conditions appear in an udder.

Chronic mastitis is more common and more difficult to detect than the acute form. Among the symptoms to watch for are changes in the milk, such as the presence of flakes or clots, or a watery or unusual appearance, slight swelling in the udder for a day or two, a rapid decrease in milk production, and high bacterial counts in the milk. The "short milker" must also be suspected.

TREATMENT AND CONTROL--Mastitis can be controlled and some types completely eliminated from a dairy herd by good management, accurate diagnosis, and treatment. Hygiene and sanitation are good preventive measures.

Proper feeding, regularity in milking, quiet handling of the animals, and good milking practices are important. Before milking, udders should be carefully cleaned with a warm chlorine or quaternary ammonium solution; a separate cleaning cloth should be used for each cow. Teats and teat cups of mechanical milkers should be dipped in an antiseptic solution after milking each cow. When hand milking, the hands should be cleaned before milking each cow.

Various tests can be used to determine the presence or absence of mastitis. Some of these, such as the use of the strip cup and the bromthymol blue and Whiteside tests, can be carried out by the dairyman, but a bacteriological examination of milk samples requires the services of a laboratory. Cows that are definitely healthy should be milked first, those suspected of having the disease should be milked next, and those definitely having the disease should be milked last. Cows should be grouped in the stable in the same manner. Even though a herd is apparently free of mastitis, the regular use of the strip cup, frequent bromthymol checks of individual animals, and periodic bacteriological examination of herd milk samples are an aid to the early detection of infection. All newly acquired cows and heifers should be tested before they are put in the milking line.

Mastitis can be treated with sulfa drugs, nitrofurazone, and various antibiotics, depending on the organism causing the disease. The drugs are usually injected into the affected quarter of the udder through the teat canal. No one treatment is effective against all the organisms that give rise to inflammation of the udder, nor does the indiscriminate use of these drugs necessarily solve the problem of mastitis in a herd. Treatment, therefore, should be part of an overall program that includes good management, sanitaton, and accurate diagnosis. A veterinarian should be consulted. The prevention and control of this disease requires constant vigilance.

FEDERAL AND STATE RESPONSIBILITIES--In most States, responsibility for the prevention and treatment of mastitis rests with the dairyman and the veterinarian. State and Federal organizations carry out research on the disease and disseminate information about it. Some States, such as Connecticut and New York, have very active programs for the control and eradication of the disease.

PUBLIC HEALTH ASPECTS--Some human diseases, such as septic sore throat, can be transmitted by careless handling to a cow's udder and thus to consumers of milk unless it is pasteurized. Organisms that cause

mastitis also affect the quality of milk. However, these organizms are not often responsible for the infection of a human being, relative to the great quantity of milk produced and consumed.

PUBLIC RELATIONS ASPECTS--Mastitis causes tremendous economic losses to dairies in the United States, but it is generally so undramatic that it is given little public notice. A few related factors will bear frequent repetition--that mastitis has various causes and requires various treatments, that the one-shot injection is never the answer, that sustained effort by the dairyman and the help of a veterinarian are needed to eradicate the disease from a herd and keep it out. Information media will find lively campaigns against mastitis in some States, and the facts given out can be keyed with the activities of this campaign. Where no such program exists, information sources can work with State livestock sanitary authorities and dairy associations to determine the most timely approach to this subject in a given locality.

FOR FURTHER INFORMATION--State veterinarians, schools of veterinary medicine, and State laboratories where milk samples are analyzed can often provide information on the disease within the boundaries of the State. Mastitis is treated at some length in Farmers' Bulletin 1422, Udder Diseases of Dairy Cows.

MUCOSAL DISEASE COMPLEX

(A group of four cattle diseases: Rhinotracheitis, mucosal disease, virus diarrhea, New York, and virus diarrhea, Indiana.)

CAUSE--All four diseases of the mucosal disease complex are believed to be caused by a virus. It is not clear whether four separate viruses or several strains of one or more viruses are involved. Because rhinotracheitis differs so markedly from the other conditions, it is believed to be caused by a separate virus. The other three conditions may or may not be caused by variants of the same virus.

AFFECTS dairy and beef cattle.

INCIDENCE--One or more of the four diseases of the complex have been reported from at least 30 States. Because the complex has been recognized so recently and because the symptoms resemble those of other diseases, animal disease authorities believe that some cases are not diagnosed and that the mucosal disease complex is probably more widespread than present reports indicate.

SPREAD--Natural means of spread have not been determined. The diseases have been transmitted experimentally by injections of blood from infected animals. Rhinotracheitis, a disease of the respiratory system, has been transmitted by spraying the virus into the windpipe.

THE DISEASE--The diseases of the complex are febrile, characterized by nasal and lachrymal discharges, salivation, similar lesions and congested areas on mucous membranes of the digestive or respiratory tracts, and diarrhea. Immunity to one of the four diseases does not provide immunity against any of the others.

Rhinotracheitis--Rhinotracheitis was first observed in Colorado in 1950. It is causing more serious economic losses than any other disease in the complex, principally because it is spreading widely through western feed lots where large numbers of animals are affected.

The disease affects the nasal passages, larynx, trachea, and sometimes the lungs. It has also been called "red nose," "necrotic rhinitis," "upper respiratory disease," and "California influenza-like disease of cattle." Incubation period in experimentally infected animals is 3 to 4 days.

In dairy cattle the first clinical symptom is a sharp reduction in milk flow, followed in about 12 hours with salivation, a thin, watery nasal discharge, and coughing. In beef cattle the salivation and nasal discharge are normally the first symptoms observed.

Temperature rises to about 103° to 108° F. or even higher. There is marked respiratory distress with rapid, shallow mouth breathing and perhaps a dry cough. As the disease progresses there may be a deep bronchial cough. The nasal discharge becomes thicker, and difficulty in breathing increases, until death may be caused by strangulation from the exudate blocking breathing passages.

Diarrhea has been observed in some cases of rhinotracheitis, but it is not necessarily typical.

Pregnant animals may abort when affected by the disease.

Dehydration is severe, with weight losses of as much as 200 to 250 pounds. The coat of affected animals is dry and rough. Eyes may be inflamed.

Cases of the disease may run a mild course, lasting only about 2 to 7 days, followed by recovery. Or the disease may become chronic, growing progressively more serious in its effects. Chronic cases are frequently fatal.

Reports of morbidity and mortality vary widely, indicating that more data will have to be analyzed before an accurate estimate can be made of these factors.

Pathological symptoms of the disease show that the effects are limited to the respiratory system. Frequently the muzzle is inflamed, which gave rise to the term "red nose." A thick cheesy exudate is found between the bones of the nose and over the mucosa of the larynx and trachea. Evidence of pneumonia may be found, particularly if pieces of the exudate have broken off and reached the lung.

Rhinotracheitis resembles some aspects of the shipping fever complex, malignant catarrhal fever, influenza, and other respiratory conditions.

Mucosal Disease--Mucosal disease was first reported from Iowa in 1951. It is an infection primarily of the digestive tract. The disease most frequently affects young animals between the ages of 8 and 14 months, but older animals have been infected. Seasonal incidence in Iowa has been greatest in winter and early spring, especially in the months of February and March. However, it has occurred in every month in the year.

First symptoms are a rise in temperature to about 106° F. 2 or 3 days, and then a drop to nearly normal. There is depression, lack of appetite, nasal discharge, and watery diarrhea. Later the diarrhea becomes severe and is frequently mixed with mucus and blood. Affected animals are markedly emaciated and dehydrated, with a rough, dry hair coat. Often there is increased salivation and lachrymation, and the cornea of the eye may become slightly opaque.

Ulcers often can be found on nostrils, muzzle, lips, gums, and in the mouth. Sometimes a foul-smelling exudate hangs from nostrils and muzzle. In some affected herds, there have been foot lesions and marked lameness. These lesions are usually crusted exudate on the skin above the coronary band and a dermatitis between the dew-claws and heels.

There are lesions, which can be ulcers, cysts, or eroded patches on the skin of the mouth and the mucous membrane of the alimentary canal.

Sometimes there are congested areas and hemorrhage in the colon. The respiratory system is not usually involved.

Morbidity rates have ranged from 2 to 50 percent. Mortality rates as high as 90 to 100 percent have been reported.

Mucosal disease is similar in symptoms to hyperkeratosis, coccidiosis, virus diarrhea, New York, virus diarrhea, Indiana, bovine malignant head catarrh, and ulcerative dermatitis of calves.

Virus Diarrhea, Ind., and Virus Diarrhea, N. Y.--The two virus diarrhea diseases, although separate entities, are similar enough to be discussed by comparison.

Virus diarrhea, N. Y., was first reported in New York in 1946, and virus diarrhea, Ind., from Indiana in 1953. Both diseases affect the respiratory and digestive systems of beef and dairy cattle. The effects upon the respiratory system are more marked in virus diarrhea, Ind. than in virus diarrhea, N. Y. In fact, effects of the strain identified in New York are generally milder than those of the Indiana strain. But cases of both diseases range from mild to severe and fatal.

Early indications of both infections are marked depression of the animal followed within several days by a nasal discharge. Mouth lesions, superficial in character, appear very early. The most characteristic symptom of the disease is diarrhea. Early in the course of the disease, feces are very hard, later becoming fluid and containing mucus and blood. Temperatures are high, ranging up to 108° F. Heart beat and respiration are rapid.

In the Indiana form a small percentage of animals affected with the disease show foot lesions and lameness. There has been no lameness observed in the virus diarrhea, N. Y.

Weight losses from virus diarrhea, Ind. are extremely heavy, ranging as high as 200 to 400 pounds. Dehydration is often severe.

Pathological observations have shown a thick exudate in the trachea and bronchi in the Indiana type. This effect is not found so often in the New York type. There are congestion, hermorrhages, and erosion of the mucosa of the digestive tract in both diseases.

Early reports of virus diarrhea, Ind., showed rather low morbidity rates, but in later cases morbidity has been very high. Sometimes entire herds are affected with the Indiana type.

Mortality rates, too, are variable. Early data showed from 0 to 20 percent of the cases were fatal. Later, over 50 percent mortality in a few herds was reported from Indiana. In virus diarrhea, N. Y., later reports show 50 percent deaths in clinical cases.

Both virus diarrhea diseases resemble epizootic enteritis, first reported from Sweden in 1946, and mucosal disease.

TREATMENT AND CONTROL--No successful method for treating any of the diseases has been developed. Most of the antibiotics used in combating

other diseases have been tested with inconclusive results. These drugs probably help to keep down secondary infections.

FEDERAL AND STATE RESPONSIBILITIES--No method of control or eradication has yet been developed. Cooperative research between State and Federal governments, with the support of industrial groups, is being carried out to develop sufficient information about the complex upon which a practical control program can be based.

PUBLIC HEALTH ASPECTS--There is no evidence that any disease of the complex affects human beings.

PUBLIC RELATIONS ASPECTS--Research studies on the mucosal disease complex are in preliminary stages. Reports made now should not be considered as final, and the public advised of this fact when the diseases are discussed. However, in order to get a full picture of the incidence and characteristics of the complex, it is important that livestock owners be advised of its existence so that reports of incidence can be more accurate. As research develops more knowledge, the information will be made available to the public.

FOR FURTHER INFORMATION--State veterinarians and Agricultural Research Service veterinarians-in-charge can provide information of the incidence and spread of the disease in each State. The Agricultural Research Service is coordinating various research projects in the States and can provide what information is available as a result of these studies.

NEWCASTLE DISEASE

CAUSE--Newcastle disease is caused by a filtrable virus that is highly resistant to destruction outside the animal body and has great spreading power. There are several foreign strains of the disease, some of which are more fatal than the domestic strain, but immunity against one strain is effective against the others.

AFFECTS mainly chickens, but also turkeys, pigeons, geese, ducks, pheasants, and other domestic and game birds.

INCIDENCE--Newcastle disease is an economically important disease of poultry all over the world. It is common in every part of the United States and is a problem in all segments of poultry production. Originally confused with fowl plague, the disease was first recognized as a separate ailment in the Dutch East Indies in 1926. Shortly thereafter, it was identified at Newcastle-upon-Tyne, England, and took its name from this occurrence.

SPREAD--Within a flock, the disease is spread by direct contact through body discharges of infected birds, including respiratory, mouth, and eye discharges, feces, and semen. Most of these secretions contaminate feed and water, and the disease spreads rapidly through a flock, usually in 3 or 4 days. The disease can be spread between flocks by poultry buyers, feed delivery men, and others, carried on footwear and clothing, reused feed bags, poultry crates that have not been cleaned and disinfected, and by various other means.

THE DISEASE--Newcastle disease is an illness involving principally the respiratory and nervous systems of fowls. It attacks chickens of all ages, from baby chicks to laying hens. The incubation period is 2 to 14 days, averaging 5 days. The first symptoms observed in chicks and broilers are difficult breathing and gasping, and the birds become depressed and weak. Nervous symptoms appear a few days later. One or both wings and legs may become paralyzed. The equilibrium is altered, and the birds may do somersaults, turn over backward, walk backward, or twist the head and neck into all sorts of contortions. In adult birds there is sudden cessation of egg production. In an outbreak of the domestic strain of Newcastle, mortality may run 5 to 90 percent in chicks, 10 to 30 percent in broilers, and as high as 65 to 90 percent in adults. Foreign strains, especially the so-called Asiatic Newcastle, cause a mortality of 100 percent in chicks and broilers and nearly 100 percent in adults.

Diagnosis may be difficult, because the disease can be confused with infectious bronchitis, laryngotracheitis, chronic respiratory disease (air-sac infection), and coryza. Laboratory diagnosis should be made by a qualified poultry pathologist. Birds that survive infection with the domestic strain of the disease take several weeks to recover and about 1 month to resume egg production. It is now a common practice to retain recovered flocks because of their immunity to further infection.

TREATMENT AND CONTROL--Medicinal treatment is of no value. A killed-virus vaccine administered intramuscularly gives reasonably satisfactory immunity for broiler production. A live-virus vaccine made from an extremely mild strain of the virus is sometimes administered intranasally to chicks as young as 1 day old; in these cases chicks should be revaccinated at about 5 weeks. A live-virus vaccine injected in the wing membrane provides durable immunity if it is used on chicks 4 weeks of age or older. Some live-virus vaccines can be administered at 2 weeks or older by spray or dust methods, and some can be given in drinking water.

Visitors from potentially infected premises should be kept away from poultry. Flock owners should insist that feed be delivered in new bags and that egg and poultry buyers use clean, disinfected crates. Dead birds should be burned or buried deep enough so that dogs and other carnivores cannot dig up the carcasses, or put in a flyproof disposal pit. Cleaning, including removal of all litter and manure, and disinfection of premises are necessary after an attack of the disease. A 2-percent solution of sodium hydroxide (lye) is recommended.

FEDERAL AND STATE RESPONSIBILITIES--The entry of poultry and certain game birds into the United States from foreign countries (except Canada) is prohibited by Federal regulations unless these conditions are met: (1) A permit is obtained from the U. S. Department of Agriculture in advance of shipment, (2) a certificate accompanies the shipment, signed by a veterinarian employed by the national government stating that the birds are free of disease and exposure to disease, and (3) birds apparently in good health are permitted to enter, subject to quarantine for a minimum of 15 days at the first port of arrival. This regulation was adopted in September 1952, after an outbreak of so-called Asiatic Newcastle disease in California, brought in by imported pheasants. The outbreak was eradicated by joint action of the Department and the State.

Some States have regulations governing the entry of diseased and exposed poultry, others do not. There are no State control programs for Newcastle disease, but most States give advice and assistance to poultry owners.

PUBLIC HEALTH ASPECTS--People occasionally contract eye inflammation and an influenza-like involvement from the virus of Newcastle disease.

PUBLIC RELATIONS ASPECTS--Since this is one of the diseases we live with, there is a problem of public apathy. Poultry journals generally do a good job of keeping their readers informed about Newcastle disease. Publications and programs of more general distribution could occasionally present the facts about the disease. One important need is to remind poultry owners of the constant danger of the spread of this disease from flock to flock by means of mechanical carriers. Prevention is the best cure for the individual flock. Any extremely virulent form of the disease, which causes a high mortality, should be reported to State or Federal livestock sanitary authorities.

FOR FURTHER INFORMATION--State agricultural experiment stations and State extension services usually have one or more poultry specialists who can provide information on the incidence and spread of the disease within the State. Current knowledge about the disease is summarized in Farmers' Bulletin 1652, Diseases and Parasites of Poultry.

PULLORUM DISEASE

CAUSE--Pullorum disease is caused by bacteria, Salmonella pullorum.

AFFECTS mainly chickens and turkeys, but natural infection has also been found in ducks, guineas, pheasants, and other fowl.

INCIDENCE--The disease occurs in every section of the United States, and of the world, where poultry are kept.

SPREAD--The primary seat of pullorum infection is in the ovary of the infected hen. It is commonly spread to the young through the egg. Chicks or poults having the disease constantly void enormous numbers of pullorum germs in their droppings, which spread the disease through polluted feed and water to other chicks and poults. The down from young birds hatched from infected eggs and even the eggshells may spread the disease.

THE DISEASE--Pullorum disease causes heavy financial losses from the death of baby chicks and poults, diminshed egg production, reduced hatchability of eggs, and occasionally the death of adult birds because of generalized infection. It is most often observed in young birds from the time of hatching to 3 weeks of age. First symptom usually noticed is that the infected birds huddle together and remain under the hover. They appear drowsy and stand about with closed eyes and ruffled plumage, occasionally picking listlessly at their feed. Their droppings may be whitish, foamy, and sticky. Sometimes the excrement sticks to the down and accumulates until it plugs the vent. Unless relieved, this condition soon results in death. Labored breathing may be observed before the death of diseased birds. Mortality may range from as low as 5 percent to as high as 80 percent in infected broods. Adult fowls seldom show outward signs of the disease, though one occasionally dies of it, but they may spread the disease through eggs used for hatching.

TREATMENT AND CONTROL--Sulfa drugs, certain antibiotics, and nitrofurazone derivatives are reported to have been used successfully to prevent death losses from acute outbreaks of pullorum disease. Use of drugs should be limited, however, to chicks or poults being raised for the market, because many of the surviving birds are carriers and none should be used for breeding. Two serum tests and one whole-blood test have been devised to detect the presence of pullorum disease in breeding flocks. Of the three, the rapid whole-blood test is more widely used for testing chickens, since the presence or absence of the disease can be determined by a skilled technician in less than 2 minutes and the bird needs to be handled only once. Turkeys are generally tested by the serum-tube or serum-plate agglutination test rather than by the whole-blood test. Birds reacting positively to the tests are removed from the

premises for slaughter, and the premises must then be thoroughly cleaned and disinfected, preferably with a 4-percent solution of cresylic disinfectant (1 cup in 2 gallons of water).

FEDERAL AND STATE RESPONSIBILITIES--The National Poultry Improvement Plan (NPIP), put into operation in 1935, and the National Turkey Improvement Plan (NTIP), put into operation in 1943, have as one of their objectives the eradication of pullorum disease in the United States (fowl typhoid was added in 1954). Forty-seven States (all except Nevada, which has very little poultry) cooperate in these plans. Two pullorum-typhoid-disease-control classifications--U.S. Pullorum-Typhoid-Passed and U.S. Pullorum-Typhoid-Clean--are used to designate the progressive status of participating flocks. Hatcheries operating under the plan are designated as "NPIP [or NTIP] Participating." An average of 4,300 chick hatcheries have taken part in NPIP each year since fiscal 1948-49. They represent about half of the hatcheries in the country and about two-thirds of the total incubator capacity. During this same period, an average of 93,289 chicken flocks having about 34 million birds were tested each year, and the percentage of reactors on first test was reduced from 0.86 to 0.24 percent. Participating in the turkey program were an average of 829 poult hatcheries and about 4,000 flocks having some 2.5 million birds. Turkey reactors on first test in this period have been reduced from 0.51 to 0.09 percent of birds tested.

PUBLIC HEALTH ASPECTS--In a very limited number of cases, S. pullorum has been reported to be responsible for human food-poisoning outbreaks of a mild nature. Since the organism is rarely encountered in mammals, it is not considered a major human health hazard.

PUBLIC RELATIONS ASPECTS--Such heavy inroads have been made into the occurrence and spread of pullorum disease that an attitude of complacency may arise--a feeling that the disease is no longer a problem. This is a dangerous attitude until complete eradication can be attained. Pullorum remains a problem of much economic importance to poultry raisers. Information sources can benefit the program and poultry growers of their area by occasionally presenting the facts on the disease and the progress being made in combating it. Although incidence of this insidious disease has been greatly reduced, there is still plenty of opportunity for it to spread, especially if vigilance is relaxed. Several occasions may arise in the course of a year for putting out information on this subject; one of them is at the time of publication of the Department's annual NPIP and NTIP reports.

FOR FURTHER INFORMATION--Pullorum disease is described briefly in Farmers' Bulletin 1652, Diseases and Parasites of Poultry. Detailed provisions of the current pullorum-typhoid-disease-control program under NPIP and NTIP are available from the Agricultural Research Service, U.S. Department of Agriculture, Washington 25, D. C. The most popular method of testing chickens for the disease and recommendations on cleaning and disinfecting premises are treated in Miscellaneous Publication 349, Use of the Rapid Whole-Blood Test for Pullorum Disease. A detailed discussion of the disease appears in Diseases of Poultry, edited by Biester and Schwarte (Iowa State Press, Ames). Today's Chicks, a motion picture (16 mm., 18 minutes, color, sound, released 1950) contains material on pullorum

disease and control measures. Annual statistics on hatchery and flock participation in the NPIP and NTIP programs are issued by the Agricultural Research Service following each fiscal year (normally in September or October); figures are given by States, by regions, and for the Nation. Current information is always available from the Department, from cooperating State agencies, and from State-supported poultry diagnostic laboratories.

RABIES

CAUSE--Rabies, also called hydrophobia, is caused by a filtrable virus.

AFFECTS mainly dogs, but can be transmitted to all domestic animals and livestock; rats, mice, and bats; wildlife, among which foxes, coyotes, and skunks have been most commonly infected; and man.

INCIDENCE--Worldwide except in a few European countries, certain islands of the Atlantic and Pacific, and Oceanica. Belgium, Great Britain, the Netherlands, and Scandinavia have eradicated the disease. It has been kept out of some Pacific islands, Australia, and New Zealand by strict quarantine. It is prevalent every year in some part of the United States.

SPREAD--Rabies virus is spread by the saliva of an infected animal, either in the course of biting another animal or person or when saliva enters the body through cuts or abrasions.

THE DISEASE--Rabies is a fatal disease of animals and man if it progresses to the stage of visible symptoms. It occurs in two forms--furious and dumb. In dogs, the first noticeable symptom may be a change of behavior. The animal may become restless, nervous, and excitable. A friendly dog may become irritable, growling, and snapping, and a less amiable animal may become friendly. The dog may disappear for a day or two, during which it wanders widely, often furiously biting animals and people; it returns exhausted and emaciated. The bark may change its tonal quality. Later the animal may develop partial paralysis, stagger about, and have difficulty in drinking because of paralysis of the throat muscles. Complete paralysis follows, then convulsions and death. In the dumb form of rabies, paralytic symptoms are the outstanding feature; none of the furious characteristics appear. The lower jaw may become paralyzed and drop, the mouth staying open 1 to 4 inches. A frequent mistake is to assume that this is caused by a bone in the throat, but the animal makes no effort to remove the obstacle; owners often expose themselves to the disease by examining the mouth and throat.

Cattle have both furious and dumb rabies, the furious type being more common. In the furious type, they become excited and restless, paw the ground, bellow in a changed voice, and tend toward violent butting rather than biting. Secretion of milk stops. Paralysis brings on the dumb form of the disease, and the animal becomes very emaciated and usually dies 4 to 6 days after the first symptoms appear. In the dumb type, the paralysis occurs at the beginning of the attack and remains until the death of the animal.

Rabid cats tend to become secretive and bellicose, dashing out from dark corners or from under furniture to attack animals or persons, especially children, jumping up to the face and inflicting wounds with teeth and claws.

Rabies in wild animals, which has become quite common both in the East and West, is an increasing threat to livestock. Nocturnal animals with rabies roam about in daytime and attack other animals and people. For instance, one rabid coyote caused the loss of 27 steers in a feedlot in the Northwest. Rabid foxes have bitten animals and persons in the South and East. Skunks were the principal offenders in the North Dakota outbreak of 1951-52, but the list also included rabid mice and rats. Over a 10-year period it is reckoned that livestock losses because of rabies, including the cost of inoculation, have totaled well over half a million dollars.

TREATMENT AND CONTROL--No treatment for this disease has ever been found for animals or persons who contract the disease and show symptoms. Prevention is the only workable method. Good animal vaccines are available that prevent the disease in nearly all cases. The number of vaccinations annually in this country has increased from less than 1 million in 1940 to more than 4.5 million in 1954. It is customary to keep the biting animal under observation for 14 days following exposure of a healthy animal to it. If it dies during that period, its brain can be microscopically examined in a diagnostic laboratory for the presence of Negri bodies (named for the Italian scientist who discovered them), which are a certain indication of rabies. There is then ample time in most instances for a course of rabies shots, generally one a day for 14 days, to be given the exposed person or animal.

The U. S. Livestock Sanitary Association points out that vaccination is only one of several means needed to eradicate this disease. It should be combined with education of the public, strict licensing of all dogs, impounding and disposal of stray dogs, strict quarantines over a sufficiently wide area, definite diagnosis and proper disposition of rabid animals and those suspected as rabid, the rigid quarantine or destruction of dogs known to have been bitten, adequate slaughter of wildlife in areas where wild animals are infected, and sufficient funds and personnel to carry out this program.

Experience has shown that the disease can be controlled if 70 percent of the dogs are vaccinated and if 75 percent of the susceptible wildlife species are exterminated.

FEDERAL AND STATE RESPONSIBILITIES--Authority rests with the States, often being divided between livestock sanitary services and departments of public health. It has generally been possible, within a year or two, to halt an epidemic of rabies in a given State, but the disease is no respector of boundaries and it always spreads to other areas, where it occasionally builds up to epidemic proportions. The U. S. Department of Agriculture participates only when rabies becomes an economic factor in livestock.

PUBLIC HEALTH ASPECTS--Rabies is a dreaded disease of human beings. About 30,000 people take the anti-rabies treatment each year in the United States for exposure to rabies or suspected rabies. A few people die of the disease each year. Public health authorities strive to protect all those who have been or may have been exposed to the disease.

PUBLIC RELATIONS ASPECTS--During rabies "scares," people read carefully the information and instructions disseminated by the various media of information. At other times, especially at the time of annual dog and cat vaccinations, they need to be reminded of the facts about rabies.

FOR FURTHER INFORMATION--Materials on this subject are available on request from the Agricultural Research Service, U. S. Department of Agriculture, Washington 25, D. C. The U. S. Public Health Service issues a folder on rabies in humans, Health Information Series, No. 30. The U.S. Fish and Wildlife Service, Department of the Interior, issues annual reports on rabies in wild animals for various regions of the country.

RIFT VALLEY FEVER

CAUSE--Rift Valley fever, named for the area of its first known occurrence in Kenya colony and protectorate (British East Africa), is caused by a filtrable virus.

AFFECTS principally sheep, cattle, and goats, but is also readily transmissible to man.

INCIDENCE--The disease has never appeared among livestock outside tropical Africa, but there have been a few cases of it among laboratory workers in America, Europe, and Japan.

SPREAD--The only proved method of spread in animals is by the bites of certain mosquitoes. Uninfected animals have been kept in screened quarters side by side with infected ones and did not contract the disease, but when grazed together in unprotected areas they become infected. Rift Valley fever is more prevalent in low swampy areas, which provide a good habitat for mosquitoes, but cases cease to appear when the animals are moved to higher altitudes. Spread of the disease to man seems to occur, however, with great ease from infected animals and material, entering the body through the nasal passages, the skin, and mucous membranes.

THE DISEASE--Rift Valley fever is an acute infectious disease, characterized in animals by a short incubation period, high fever, high abortion rates in pregnant ewes and cows, and heavy mortality in young lambs and calves, often accompanied by an influenza-like infection among persons closely associated with the animals. First symptom noticed in animals is a high fever, which may occur 20 to 72 hours after exposure.

The symptoms are often indefinite in young lambs, and the disease runs its course in a very short time. The animal is not inclined to move, refuses to eat, and often shows abdominal pain; it may die within 24 hours without showing any symptoms. The mortality in newborn lambs may run as high as 95 percent. The disease often passes unnoticed in adult sheep, which may vomit or abort as the only evident symptom, and some may be found dead. Mortality in adult sheep seldom runs more than 20 percent.

The symptoms are frequently indefinite in cattle. There is usually a brief period of fever, the animal drools profusely, has no appetite, shows severe abdominal pain, has a fetid diarrhea, its coat becomes rough, lactation ceases, and pregnant cows often abort. Mortality is highest among calves, but deaths in all age groups of cattle usually do not exceed 10 percent. Internally, the liver of affected animals appears to suffer most damage.

A characteristic feature of the disease is the rapid decomposition of the carcass after death.

Careful laboratory examination is necessary for a positive diagnosis of Rift Valley fever. In addition to necrosis of the liver, a low count of white blood corpuscles is typical. White Swiss mice are highly susceptible to this disease, dying 2 or 3 days after an intraperitoneal injection of the virus. Serum-neutralization and complement-fixation tests are used for the diagnosis of recovered cases. The disease is easily confused with enterotoxemia, bluetongue, ephemeral fever, brucellosis, vibriosis, trichomoniasis, Nairobi sheep disease, enzootic abortion in ewes, and parasitic infestation.

A serious epidemic in the Union of South Africa in 1950-51 spread over 12,500 square miles of territory, killed about 100,000 lambs and 50,000 to 100,000 sheep, and there were about 200 confirmed human cases.

TREATMENT AND CONTROL--No medicinal treatment has been found which cures or alleviates this disease in livestock. Hyperimmune serum has been used to protect young lambs and special cases in adult animals. Modified live virus vaccines passaged in mouse brain and chicken embryos have been used successfully in South Africa. Mosquito control and transfer of animals to higher altitudes are helpful preventive measures.

FEDERAL AND STATE RESPONSIBILITIES--Since this disease has not entered the United States, the principal responsibility rests upon the Federal Government to keep it out.

PUBLIC HEALTH ASPECTS--Illness of human beings is often one of the first indications of an outbreak of Rift Valley fever in livestock. The incubation period in man varies from 4 to 6 days, and onset of the disease is sudden. First symptoms are nausea, chills, fever of 102° to 104° F., pain in the pit of the stomach, a feeling of fullness in the area of the liver, and a total aversion to food. This is followed by violent headache, an abnormal sensitiveness to light, aching of the back and joints, dizziness, and sometimes nosebleed. The fever usually lasts 2 to 3 days, but may continue 10 days or more. When it subsides, the symptoms subside with it. Sometimes there is a second rise of temperature about the sixth day, accompanied by a recurrence of symptoms. The disease is almost never fatal to man. Recovery is followed by long and lasting immunity, but serious aftereffects may include damage to the heart and to the retina of the eye.

The disease has occurred among farmers who tend infected flocks, veterinarians who perform post-mortems on diseased animals, butchers, delivery boys, and housewives who have handled infected meat. The disease does not appear to spread within a family.

PUBLIC RELATIONS ASPECTS--Should Rift Valley fever appear in the United States, the fact that it affects people and that it is a little-known disease may cause a certain amount of apprehension or even hysteria. Information sources will be in a position to calmly state the facts, which

are more reassuring than with some diseases, because Rift Valley fever is seldom fatal to man and can be combated in animals by vaccination.

FOR FURTHER INFORMATION--This brief treatment on Rift Valley fever is based on an article by Dr. M. W. Henning in the Journal of the South African Veterinary Medical Association, Vol. XXIII, No. 2, June 1952, pp. 65-78; on a paper (1952) by Dr. David Haig of the Union of South Africa; on the treatment in Foreign Animal Diseases, by the U. S. Livestock Sanitary Association; and on the knowledge of Department scientists. Further information is available in technical journals.

RINDERPEST

CAUSE--Rinderpest is caused by a filtrable virus. Only one type of the virus is known but there are various strains that have definite differences in virulence (disease-producing ability). These strain characteristics appear to be quite constant when the virus passes from one animal to another.

AFFECTS cattle and buffalo, which are most susceptible, and wild animal ruminants (cud-chewing animals), including deer and antelope.

INCIDENCE--Rinderpest has never appeared in the United States. It has been known since ancient times in Asia, Africa, eastern and southeastern Europe. It is one of the deadly diseases of livestock against which many precautions are taken to prevent its introduction into this country; the importation of cattle from a country in which rinderpest exists is prohibited by law.

SPREAD--The disease is spread for the most part by contact of sick with healthy animals. The virus is present in blood, saliva, urine, feces, nasal and vaginal discharges; hence, feed, water bedding, and premises become easily infected. The virus can also be carried on shoes, clothing, and vehicles.

THE DISEASE--Rinderpest is an acute, febrile, infectious disease mainly involving the digestive organs. The first apparent sign of the disease is a very high fever, of 106° F. or higher, often with repeated chills. The head droops and rests on some support. One or both ears may droop. The muzzle is dry and the coat lusterless. The back arches and the legs are drawn together under the body. Milk production drops off, sometimes two-thirds in 12 to 20 hours. Respiration and pulse are accelerated. The mucous membranes of the mouth, nose, eyes, rectum, and vagina become scarlet or dark red. There is a profuse shedding of tears, followed later by a pus-bearing discharge from the eyes. The animal coughs frequently and painfully. Constipation during the fever is followed by hemorrhagic diarrhea. There is marked loss of weight, and death ordinarily ensues in 4 to 7 days. The mortality in a herd may run 75 percent or higher.

Rinderpest ordinarily does not spread as fast as foot-and-mouth disease (partly because of its incubation period of 3 to 14 days), but in many epidemics it has spread with great rapidity.

Clinical diagnosis of rinderpest may prove somewhat difficult should the disease appear in the United States, for not all symptoms occur in every case. Certain symptoms in one epidemic may not appear in another. However, trained diagnosticians can arrive at a diagnosis by serological and biological tests, the latter by challenging uninfected animals with the virus.

TREATMENT AND CONTROL--Rinderpest is a disease with which the United States has had no experience. But, because it is such a deadly ailment, a great deal of attention has been given to the means of control and eradication should it be introduced. It has been considered that the slaughter method used in outbreaks of foot-and-mouth disease would be the best to insure eradication--quarantine and diagnosis followed by appraisal, prompt slaughter and burial of affected and exposed animals, cleaning and disinfection (with a 2-percent lye solution) of infected premises and the placing of test animals. As of now, this appears to be the most likely method, though vaccines have been used effectively in some countries where the disease is endemic or where wild ruminants act as reservoirs of infection.

FEDERAL AND STATE RESPONSIBILITIES--In the event of an outbreak, a Federal-State agreement would be reached and the disease would be handled by a cooperative program of eradication or control.

PUBLIC HEALTH ASPECTS--So far as known, the disease is not communicable to human beings.

PUBLIC RELATIONS ASPECTS--Problematical, but in all likelihood similar to those involved in foot-and-mouth disease. Great excitement among livestock owners can be expected if an unknown foreign disease with such a high rate of mortality should suddenly appear in this country. Unjustified quarantines, embargoes, and market disruptions might occur, even with the most objective reporting of a rinderpest outbreak. Announcement should be withheld until definite diagnosis is made. The facts can then be told as calmly as possible and should include reassurances that human health is not involved, that the disease does not spread as fast as foot-and-mouth disease, and that experienced professional men are in charge of the situation.

As in the case of a foot-and-mouth outbreak, an experienced information man will be on the scene within hours to provide the press and other information media with all available facts.

FOR FURTHER INFORMATION--Some information on rinderpest is included in the U. S. Department of Agriculture publication PA 167, Defense Against Foreign Animal Diseases (available in some libraries). Technical information is given in Foreign Animal Diseases, issued by the U. S. Livestock Sanitary Association. The Department of Agriculture has a technical motion picture, Rinderpest, its Recognition and Control, color, sound, 20 minutes, released in 1955. Rinderpest "study sets," made up of color slides and tissue sections, are available on loan from the Armed Forces Institute of Pathology to professional groups in veterinary colleges and diagnostic laboratories. Information on a specific outbreak will be available at the headquarters established to handle the break.

SCABIES

CAUSE--Scabies, scab, or mange, as it is variously called, is caused by minute parasitic mites that feed on the skin of some domestic animals. Four kinds of mites (psoroptic, sarcoptic, chorioptic, and demodectic) are the principal types that affect sheep and cattle, though each species of animal is afflicted with different varieties of mites.

AFFECTS cattle, sheep, goats, hogs, horses, dogs, cats, and man. Each species of domestic animal has its own variety of scab, which is generally not passed on to other species of animals. However, psoroptic scab has been passed back and forth experimentally between cattle and sheep, and goats have been known to carry scabies of sheep. Man can contract sarcoptic scab from animals, and it can be transmitted from person to person.

INCIDENCE--Scabies in one form or another occurs throughout the United States. Because of a widespread program of eradication through dipping of animals, psoroptic or common scab is now much less common in cattle than the chorioptic and sarcoptic forms.

SPREAD--Scabies is a contact disease, the mites passing from one animal to another. This is facilitated by the fact that animals often rub against each other to relieve the furious itching caused by the activities of the mites. Bulls may also pass the infestation to cows, and man may contract the sarcoptic form while milking. There is little indication that the mites live long in barns or in litter, but to guard against this possibility it is recommended that litter be burned and premises disinfected when animals are treated.

THE DISEASE--Scabies is a highly contagious skin disease caused by mites so small that they can barely be seen with the naked eye. The scab mite pricks or burrows in the skin to obtain nourishment, and causes inflammation. As the mites multiply, large numbers of small wounds are made in the skin, causing intense itching, inflammation, and the oozing of blood serum. The serum becomes mixed with dirt and more or less infected with microorganisms. This mass soon hardens into yellowish or gray scabs, frequently stained with blood. The animal is constantly irritated and spends so much time rubbing, licking, biting, and scratching that it has very little time for feeding. As the disease spreads to larger and larger areas of the skin, the animal loses flesh, becomes weak and emaciated, and, unless relief is provided, finally dies. This describes common scab of cattle, to which other forms in cattle and other animals are generally similar.

Scabies is a disease of considerable economic importance. It causes shrinkage in weight, failure of young stock to thrive and gain, loss in milk production, and loss of vitality, which makes animals liable to other infections. Thus, both as a primary and secondary cause, scabies raises the death rate in flocks and herds.

Diagnosis should be made by a veterinarian when the first symptoms of scratching and rubbing are noticed. It is necessary to find and identify the mite in order to diagnose the ailment, which can be confused with the discomfort caused by lice and ticks. Furthermore, it is necessary to know the kind of mite, in order to carry out the proper schedule of spraying or dipping. Demodectic or follicular mange, for example, is caused by a wormlike mite that bores into the hair follicles and is very difficult to destroy.

TREATMENT AND CONTROL--Animals found to have scabies should be isolated to prevent the mites from spreading to other animals. Curry combs, brushes, and blankets used on infested animals should be disinfested. Treatment of the disease should be given to the whole herd, both infested and uninfested animals. Spraying and dipping of cattle, dipping of sheep and goats, and hand applications, medicated wallows, and dipping of hogs have been found effective in treating most forms of scabies. Dipping in nicotine or lime-sulfur solution kills most mites but does not kill the eggs, which hatch in 4 to 7 days. It is necessary to dip again in 10 to 14 days in order to kill the second crop of mites before they begin laying eggs. Suspensions of the wettable powders of benzene hexachloride (BHC) and lindane are in some cases more effective and, if used with proper care, are recommended by the Department of Agriculture; the emulsifiable concentrates are not recommended. Crude petroleum dip is a cure for sarcoptic scab, but great care is necessary in handling animals after dipping to prevent injury to them. Somewhat different schedules for treating and dipping are used for hogs than for cattle and sheep.

FEDERAL AND STATE RESPONSIBILITIES--Federal regulations permit the interstate movement of cattle or sheep infested with or exposed to scabies, provided the animals are dipped before interstate shipment under supervision of the Agricultural Research Service. Permitted dips for interstate movement were formerly only nicotine and lime-sulfur solutions, but the Department of Agriculture announced April 29, 1954, that wettable powders of BHC and lindane were acceptable. Cars, trucks, pens, sheds, chutes, and other premises and facilities used by cattle or sheep found to have scabies during interstate transit must be thoroughly cleaned and disinfested under supervision. Meat inspection regulations require condemnation of carcasses having such advanced cases of scabies that the flesh is extensively inflamed.

The Agricultural Research Service cooperates with the States in quarantining and suppressing outbreaks of scabies in sheep, cattle, and goats, but outbreaks in hogs and other animals, being of less economic importance to the livestock industry, are left to individual owners. Most States have laws and regulations for dealing with this disease.

PUBLIC HEALTH ASPECTS--Sarcoptic scab is transmissible from animals to man and from one person to another. An outbreak in the British Army during World War II and among the civilian population, spread by contact in air raid shelters, assumed such proportions that a motion picture was made to broadcast methods for dealing with it. Ordinarily, however, human infestation is of relatively minor importance.

PUBLIC RELATIONS ASPECTS--Scabies outbreaks sometimes cause great concern in an area, and there have been times when States have

declared embargoes against neighboring States. Information outlets, while presenting accurate information about the disease and its occurrence, should do what is possible to encourage, within the bounds of existing regulations, the normal commercial movement of livestock.

FOR FURTHER INFORMATION--State livestock sanitary officials and Federal veterinarians in charge are the best sources of information for occurrence of scabies in a given area, measures taken, and the lifting of quarantines. Further information on the types of scabies in different species of animals and on dipping preparations and procedures is available in the following Farmers' Bulletins: 713, Sheep Scab; 1017, Cattle Scab and Methods of Control and Eradication; and 1085, Hog Lice and Hog Mange.

SCRAPIE

CAUSE--Scrapie is a chronic infectious disease caused by a filtrable virus, which is present in the brain and spinal cord of an infected animal.

AFFECTS principally sheep. It has also been found among goats on the continent of Europe.

INCIDENCE--Scrapie is reported to have existed in England, Germany, and France for more than 200 years. New Zealand and Australia reported that they had eradicated the disease after it appeared in 1952 in sheep imported from England. The first case in North America occurred in Canada in 1938. Three others have since been reported in the Province of Ontario, one in 1945, one in 1951, and one in 1952. The disease first appeared in the United States in Michigan, 1947. From 1952 through 1955 it had occurred in 13 other States--California, Connecticut, Georgia, Illinois, Indiana, Iowa, Missouri, New York, North Carolina, Ohio, Oregon, Tennessee, and Texas.

SPREAD--All methods of spread are not known. Progeny of infected animals often develop the disease. Limited studies indicate that it might be spread by infected pastures.

THE DISEASE--Scrapie has an extremely long incubation period, extending from 18 months to 3 years and longer in some instances. For this reason, it rarely appears among lambs. Although the long incubation period prevents explosive outbreaks, it makes eradication more difficult.

Usually the first symptoms, restlessness and excitability, are hard to recognize. The wool loses its luster and becomes dry and harsh. The most characteristic symptom is intense itching, causing the infected animal to scrape off patches of wool from the sides, back and rump, sometimes breaking the skin. The infected animal has a scratch reflex. When an animal rubs against something or is purposely scratched, it makes biting movements with the lips and teeth. At this stage, the disease may be confused with scabies. Also in scrapie there is a progressive lack of coordination, accompanied by convulsive seizures and cumulative weakness. The infected animal carries the head high and somewhat stiffly and may stand with its feet wide apart. The gait becomes unsteady, and the animal may walk sideways, stumble, and fall down. An excited animal when running may fall down in a coma, which may last for several minutes. There is usually no loss of appetite, and the temperature is normal. Thirst is a frequent symptom. There is no diarrhea, but if the animal is excited quantities of feces and urine may be involuntarily passed at short intervals. The animal gradually loses flesh, goes down, and usually dies. The course of the disease runs from 6 weeks to 6 months or longer, up to 14 months.

TREATMENT AND CONTROL--No treatment is known. Because of the unusually long incubation period, normal measures of inspection and quarantine are not as effective against scrapie as they are against other diseases. However, since 1952 the U. S. Department of Agriculture and the various State governments concerned have cooperated in imposing State and Federal quarantines when scrapie is diagnosed. These quarantines are lifted after infected and exposed animals have been slaughtered and disinfection measures have been completed.

The most effective means now available of combating the disease is the destruction of infected and exposed animals as soon as possible, followed by complete cleaning and disinfection of the contaminated premises. Any animals brought into or sold from the infected flock are then traced to determine the original source of infection and the full extent of the spread of the disease.

Animal disease authorities do not now believe that the development of an effective vaccine is practical because of the long incubation period of the disease.

FEDERAL AND STATE RESPONSIBILITIES--As in other animal-disease control and eradication efforts, quarantines controlling the interstate movement of animals from areas affected with scrapie are a Federal responsibility. When requested to do so by State authorities, U. S. Department of Agriculture veterinarians also aid in making final diagnosis, in the destruction of infected and exposed animals, and in cleaning and disinfection measures. The Department's Animal Disease Eradication Branch, in cooperation with State livestock sanitary officials, traces the origin of infected animals.

State governments are responsible for enacting and enforcing local quarantines within State boundaries and for carrying out eradication and control measures within the State when an outbreak occurs.

PUBLIC HEALTH ASPECTS--No case of scrapie in human beings has been reported.

PUBLIC RELATIONS ASPECTS--The appearance of scrapie has a tendency to frighten sheep owners. The long incubation period makes it difficult to handle, and the high mortality rate may cause severe losses. Breeders will want as much information as possible about the disease, which is still new to this country and largely unknown to many owners.

FOR FURTHER INFORMATION--There are few nontechnical publications on scrapie available in this country. A technical discussion of the disease appears in Foreign Animal Diseases, published by the U. S. Livestock Sanitary Association. The best source of information is the State or Federal veterinarian, or the Agricultural Research Service, U. S. Department of Agriculture. A technical film entitled Scrapie--an Obscure Disease of Sheep (16 mm., color, sound, 8 minutes) was released in 1954.

SHIPPING FEVER

CAUSE--Shipping fever is caused by an agent as yet unidentified in spite of renewed research in recent years; perhaps it is a virus. Pasteurella boviseptica, which is often found in postmortem examinations and was formerly thought to cause the disease, is now regarded as probably a saprophyte--an organism that lives on dead or decaying matter. This conclusion is based on the fact that healthy animals inoculated with a pure culture of P. boviseptica usually fail to contract the disease. It is now believed that this organism causes secondary infection after initial attack by a virus.

AFFECTS cattle and sheep, but mostly cattle.

INCIDENCE--Shipping fever occurs in cattle of all ages in all parts of the United States; weanling calves are most susceptible. It is particularly prevalent in feeder cattle just after their movement from the ranges to the feedlots, especially in the Corn Belt and other grain-raising areas in the fall of the year, when most of this movement takes place.

SPREAD--Shipping fever spreads rapidly from animal to animal. When infected animals are placed, after shipment, among local stock, some uninfected animals contract the disease. Contaminated yards, sales barns, transport facilities, and equipment are sources of spread.

THE DISEASE--Shipping fever is an infectious respiratory disease that causes more cattle to die than any other ailment. As indicated by the name, it occurs after the stresses of shipment. Signs of illness usually appear within 10 days after the animals arrive at their destination, 5 to 14 days after first exposure. Early signs are usually a tired appearance, reduced appetite, and a mild cough. Temperatures run 105° to 107° F. in animals that are visibly affected and in some that still appear normal. Affected animals soon show depression, a gaunt appearance, and often have a watery discharge from nose and eyes. Until recent years the disease often ran a mild course; many cases would recover in a few days without treatment. A few would contract pneumonia and die in 48 to 72 hours. About 1950, however, the disease became more widespread and, in some areas, much more severe. Many affected animals died in 24 hours. Staggering losses were avoided only by the alertness of caretakers and improved methods of treatment. When treatment is delayed, the disease may take a chronic course, lingering on for several weeks. Recovered animals often remain unthrifty.

Shipping fever may be confused with anthrax, the early stages of blackleg, or leptospirosis. However, when animals that have been recently shipped develop the characteristic symptoms, shipping fever should be suspected. Diagnosis, treatment, and methods of control should be left in the hands of a veterinarian. The diseases with which it may be confused

are very serious, and shipping fever with leptospirosis can be highly fatal. Mortality from shipping fever alone is about 20 percent of the animals affected.

TREATMENT AND CONTROL--Good care before, during, and after shipping is recommended as one of the best means of reducing losses from this disease. Buyers should, as far as possible, purchase only healthy animals. Much effort should be placed on avoiding infection and preventing stresses on the animals in the course of shipping. Rounding up for shipment should not be combined with castration, dehorning, or any other activity that saps the vitality of the animals. Cattle being assembled for shipment should not be overdriven, and dusty trails should be avoided if possible. Before loading they should be rested, fed native grasses, then watered. Rough handling while loading and overcrowding in cars or trucks should be avoided. In cold weather the animals should have plenty of bedding while in transit, and the interior of the vehicle should be lined with heavy building paper to a level above the heads of the animals. Feed, water, and rest should be provided at proper intervals en route. After arrival at destination the animals should have adequate dry, open-air shelter during cold, wet, and stormy weather. They should have access to dry roughage for a few hours, then should be watered sparingly. With special attention, the vitality lost on the trip can be recovered. Shipped-in stock should be segregated from other cattle for at least 10 days to lessen the danger of introducing infection.

Serums, bacterins, and aggressins previously used to immunize cattle against shipping fever are no longer recommended--since the causative agent of the disease has not been determined, it obviously cannot be used to make an effective vaccine. Controlled experiments have shown that various vaccines are either unhelpful or actually harmful.

Should the disease appear in spite of all precautions, the next step is prompt diagnosis and treatment by a veterinarian. Remarkable response has been found to treatment with antibiotics, particularly streptomycin, and certain sulfa drugs. In some serious outbreaks, the number of cases developing in herds has been greatly reduced by treatment with effective drugs administered on arrival or up to 5 days thereafter. Animals requiring prolonged treatment may suffer from loss of appetite and constipation. This may be owing to drugs interfering with the microorganisms in the rumen, which are so important to digestion. Such animals usually respond to inoculation of the rumen with a fresh supply of the required microorganisms. Overdosage with sulfa drugs may also cause serious damage to the kidneys, resulting in lingering illness and death.

Animals that die of shipping fever should be removed promptly and buried. Stables, feed bunks, and tanks that have been contaminated by sick animals should be thoroughly cleaned and disinfected as soon as the animals recover or are removed. They should be exposed to sun and air until it becomes necessary to use them again. Recommended disinfectant is a compound cresol solution, 4 ounces to a gallon of water, or carbolic acid, 6 ounces to a gallon of water.

FEDERAL AND STATE RESPONSIBILITIES--The Federal 28-Hour Law prohibits consecutive interstate transportation of livestock for more than 28 hours (or, at the written request of the shipper, 36 hours) before unloading the animals in properly equipped pens for rest, water, and feed.

At least 5 hours is required by law, but stocker and feeder cattle not in good condition should rest longer. Although this law was passed as a humane measure, without reference to shipping fever, its provisions fit in with the need to care for animals so they do not lose vitality and become prey to this disease.

PUBLIC HEALTH ASPECTS--No cases are known of human beings contracting shipping fever.

PUBLIC RELATIONS ASPECTS--Especially during inclement weather in the fall, winter, and early spring, in areas where many cattle are shipped, it is wise to issue warnings about the care of animals in transit and the dangers of shipping fever. Animals well cared for in transit pay dividends at the slaughterhouse and feedlot. Shipping fever causes heavy economic losses, estimated by the U. S. Department of Agriculture at $25 million a year. A description of the disease once or twice a year is well worth the effort.

FOR FURTHER INFORMATION--State veterinarians, Federal veterinarians in charge, and practicing veterinarians may have information on shipping fever, especially in areas where many cattle are shipped and during the season of greatest incidence. Farmers' Bulletin 1018, Shipping Fever of Cattle, gives information on this disease. A closely related publication is Leaflet 38, Maintaining the Health of Livestock in Transit.

SWINE ERYSIPELAS

CAUSE--Swine erysipelas is caused by a slender rodlike bacillus called Erysipelothrix rhusiopathiae. Although it does not form spores, this organism is very resistant to adverse conditions and can live for years in the soil.

AFFECTS hogs, has been of economic importance in turkeys and sheep, occasionally infects other domestic animals, and is not uncommon in man.

INCIDENCE--Swine erysipelas has been for many years one of the most important diseases of hogs in Europe and has become one of the more important hog diseases in the United States, particularly in the Midwest.

SPREAD--It is believed that hogs pick up the infection through contaminated feed and water, since the organism is expelled by infected and carrier animals in the feces and urine. Feeding raw garbage containing pork scraps may be a source of danger. The infection may also enter the body through minor cuts and scratches and by biting insects, but the means of spread is not entirely understood.

THE DISEASE--Swine erysipelas is an insidious and often deadly disease. In the acute stage there may be one or more sudden deaths in a herd. Animals may run a temperature of 105° to 110° F., lose their appetite, and lie in their beds. Their eyes remain clear and active, however, and when disturbed they move out with alacrity, then protest with loud squeals. When the joints are affected, the animals tend to keep their legs well under them, and have an arched back and stiff gait. In one form of the disease, diamond-shaped, dark-red or purplish areas appear on the skin and turn white when pressed; before this condition was associated with erysipelas, it was known as "diamond-skin disease." Hogs that survive the acute stage may completely recover or they may have chronic arthritis or "rheumatism," characterized by stiff and enlarged joints that cause them to lie on their breastbones or to sit upright. This may be followed by a gangrenous affliction of the skin; parts of the skin, including that of the tail and ears, may slough off.

The disease is difficult to differentiate from hog cholera and several other diseases. A positive diagnosis of this disease must include finding the organism by laboratory examination.

TREATMENT AND CONTROL--After an outbreak of swine erysipelas, healthy animals must be removed to clean ground and treated with anti-swine-erysipelas serum. Visibly affected animals, if not too far gone, should be removed to a pen away from healthy hogs and given serum and penicillin. This treatment often brings spectacular results within 24 hours. Hogs having the chronic form of erysipelas should be destroyed, since they rarely pay their way and are a source of further infection.

Dead animals should be buried so deep that dogs, rodents, and other hogs cannot reach them; the carcasses should be covered with lime. Infected houses, pens, feeding troughs, and other equipment should be thoroughly scraped, scrubbed, and disinfected with a hot 2-percent lye solution.

Litter and manure from infected houses and pens should be spread on fields to which hogs have no access. If possible, the hog lot should be abandoned for this use, planted, and subjected to soil rotation in order to reduce infection in the soil.

Immunization of swine with combined live-culture vaccine and antiserum is largely effective in preventing outbreaks of swine erysipelas.

FEDERAL AND STATE RESPONSIBILITIES--The Agricultural Research Service has a cooperative program with about half of the States, including those of the Middle West, to help get rid of swine erysipelas. These States have signed a memorandum of understanding with the Department that enables them to obtain combined live-culture vaccine and serum for the use of their veterinarians. Because the live-culture vaccine is infectious to human beings and can infect animals, States entering this compact have various laws as to how the vaccine and serum can be obtained and administered. The serum alone is generally available.

Federal regulations prohibit the movement across State lines of diseased and exposed livestock, including hogs with erysipelas. Meat inspection regulations require that animals or carcasses with acute or generalized swine erysipelas when entering packing plants be condemned and destroyed.

PUBLIC HEALTH ASPECTS--Swine erysipelas can be transmitted to human beings through breaks in the skin. Starting as a local irritation at the point of infection, the disease enters the bloodstream and develops as a form of blood poisoning. It can be treated with antibiotics. Butchers and other handlers of livestock products and persons engaged in making live-culture vaccine are rather frequently infected.

PUBLIC RELATIONS ASPECTS--Swine erysipelas is one of the major swine diseases. Effective agents are available to prevent the disease and to treat it when it occurs. Swine owners will want the facts as to the nature of the disease, the care needed to get rid of it, and the location and extent of any current outbreak.

FOR FURTHER INFORMATION--State livestock sanitary authorities and Federal veterinarians in charge are the best source of information on occurrence and outbreaks within their area. Swine erysipelas is briefly discussed in Farmers' Bulletin 1914, Diseases of Swine.

TESCHEN DISEASE

CAUSE--Teschen disease, named for an area in Czechoslovakia where it was first recognized in 1929, is caused by a filtrable virus. The disease is also known as Bohemian pest, porcine encephalomyelitis, and infectious pig paralysis. The virus is resistant to drying, heating, pickling, and freezing, but is readily killed by sunlight or by a 3-percent lye solution.

AFFECTS only hogs, with a preference for young animals.

INCIDENCE--The disease has been identified in Europe, where it causes serious mortality in swine herds of several countries, notably Austria, France, Germany, Hungary, Italy, Switzerland, and Yugoslavia. The breakdown of veterinary sanitary controls during World War II gave the disease an opportunity to spread far beyond its previous range. Teschen disease has not been diagnosed in the United States.

SPREAD--The means of dissemination is not entirely understood. Biting and sucking insects have been ruled out for the most part, because the disease occurs in all seasons. There is a suspicion that the virus may be spread through the feeding of infected pork scraps in raw garbage, but tests have shown that the disease is difficult to spread by mouth. The respiratory route of entry into the animal seems more worthy of suspicion: pigs are readily infected by nasal inoculation.

THE DISEASE--Teschen disease is a virulent, contagious affliction of swine causing acute inflammation of the brain and spinal cord and paralysis of various parts of the body, in some of its effects resembling poliomyelitis in human beings. Incubation period averages about 14 days.

The disease occurs in four forms, of which the acute is most frequently observed. The others are subacute, chronic, and inapparent. An early symptom is fever of 104° to 105° F., rarely exceeding 106°. The animal shows fatigue, prostration, lack of appetite, sometimes constipation and vomiting. Another early symptom is lack of muscular coordination, evidenced by a peculiar gait. As the disease progresses, the temperature returns to normal and the animal shows acute paralytic symptoms, beginning usually in the hind legs and spreading to all four legs. The animal staggers, falls, and creeps on all fours. By the second or third day it is no longer able to stand, and its legs make constant running motions. As the paralysis spreads to the respiratory organs, the temperature sinks below normal, and the animal goes into a coma and soon dies. Most animals that succumb to the disease do not live through the first week. Mortality is high among animals affected, sometimes reaching 80 percent. Among the few that recover, convalescence is long and difficult.

In the chronic form, which occurs mostly in adult hogs, there is rarely any fever, but the animal shows evidence of fatigue, frequently lies down,

and moves uncertainly and with difficulty. It becomes thin and emaciated, and its hind quarters become partially paralyzed. The affected animal is quite alert and its senses and appetite are unimpaired. The chronic form may last several weeks to several months. Mortality is about 20 percent, usually caused by a complicating illness.

The disease is sporadic in its attacks, sometimes affecting a few animals in a herd, at other times affecting nearly all. Some outbreaks follow each other in periods of a few days; at other times the waves of contagion may wait for weeks or even months.

Teschen disease may be confused with hog cholera and swine erysipelas, as well as rickets and various other diseases caused by nutritional deficiencies.

TREATMENT AND CONTROL--No treatment has been found that cures or significantly alleviates this disease. Vaccines have been used with variable success in Europe. The best treatment, especially for the United States and other countries where the disease has not yet appeared, is to keep it from coming into the country. Nations in which it has appeared--except those that have depended on vaccination--have followed the eradication method, including slaughter of diseased and exposed animals, sanitary disposal of carcasses, disinfection of premises, and control of livestock movements.

FEDERAL AND STATE RESPONSIBILITIES--Should Teschen disease appear in the United States, in spite of the precautions being taken to exclude it, every possible means would be used to eradicate it through State and Federal cooperative action.

PUBLIC HEALTH ASPECTS--Several attempts have been made to show a relationship between poliomyelitis and Teschen disease, but there seems to be no connection. So far as known, Teschen disease presents no public health problem.

PUBLIC RELATIONS ASPECTS--The appearance of Teschen disease in the United States would doubtless cause a panic reaction among swine owners. No announcement of the disease should be made until diagnosis is made by a showing of lesions in the brain of an infected hog. Information about the disease should then be given in a matter-of-fact way. The rumor--almost certain to arise--that this swine disease is a form of human polio can be refuted by pointing out that the viruses are different and that the Teschen virus does not attack people. Plans for eradication of the disease can be announced as they are formulated.

FOR FURTHER INFORMATION--Other than this brief account, the U.S. Department of Agriculture has no publication on this subject. The disease is technically described in Foreign Animal Diseases, issued by the U.S. Livestock Sanitary Association. The Department of Agriculture has a technical film, Teschen Disease (16 mm., 11 minutes, black-and-white, sound, released 1953).

TICK FEVER

CAUSE--Tick fever (variously named Texas fever, Mexican fever, redwater, piroplasmosis, and splenetic fever, to mention a few of its names) is caused by a protozoan microorganism, Piroplasma bigeminum. It is spread only by the cattle tick.

AFFECTS only cattle.

INCIDENCE--Tick fever exists in various warmer parts of the world, including regions of Mexico, from which it sometimes enters the only remaining tick-quarantined section of the United States--a narrow buffer zone in Texas along the 550-mile stretch of the Rio Grande from Devils River southeast to the Gulf of Mexico. In 1906, when the former Bureau of Animal Industry began its campaign against tick fever, this disease was widespread in Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, and South Carolina, and existed in parts of California, Kentucky, Missouri, North Carolina, Oklahoma, Tennessee, Texas, and Virginia--one-fourth of the area of the United States.

The latest major outbreak in the country was in Florida in 1950. The tropical variety of the cattle tick, encountered in the United States for the first time in southern Florida, proved exceedingly difficult to eradicate because it infests deer as well as cattle. In certain swamp areas of Florida, the successful conclusion of the cattle-tick eradication program depended on a marked reduction of the deer population, in addition to the systematic dipping of cattle.

SPREAD--Tick fever does not spread by contact from animal to animal. It is carried by the cattle tick, Boophilus annulatus, and its tropical variety. The infection exists in the eggs of the engorged female, which may number 1,500 to 3,000, and continues in the tick through its three stages of development--seed tick, nymph, and adult--all of which are passed on the same host animal.

THE DISEASE--This is a specific, infectious, and frequently fatal disease of the blood of cattle. An animal having the acute form of the ailment runs a temperature within 24 to 48 hours of 107° to 108° F. It leaves the herd and lies down or stands by itself with head lowered, ears drooped, feet drawn together, back arched. The muzzle is dry, the appetite lost, and rumination ceases. Constipation in the early stage of the disease gives way later to diarrhea. Respiration and pulse increase to a very rapid rate. Protozoa in the circulation break up the red corpuscles, releasing hemoglobin, which is often discharged in the urine, making it pink or red in color, and giving rise to the name redwater for the disease. Mucous membranes become pale and bloodless as the anemia advances. Death usually occurs in 3 or 4 days. In chronic cases, which are more common in winter, the temperature does not exceed 105° F., symptoms of anemia

are seen but the urine is not stained, and there is excessive loss of flesh; the animal usually recovers. Animals dead of the acute form show a marked lack of blood, an enlarged and bile-swollen liver, a distended gall bladder, and an enormously enlarged spleen. The kidneys are usually congested and very dark in color.

The mortality in adult cattle may vary considerably, ranging from 10 percent of the chronic cases to 90 percent of the acute cases. The disease is more serious in adult cattle. When calves under 8 months of age become infected they usually have a mild case and become immune to further attacks.

Conservative estimates in the early years of this century placed the losses directly and indirectly chargeable to this plague at $40 million annually. In 1928, estimates showed that the loss per head on ticky cattle marketed for beef ran $3 to $9 a head, that tick-damaged hides brought $1.25 to $2.10 less than those not damaged, and that milk production shrank an average of a quart per cow per day. More feed was needed, of course, to support the ticks, which infested a single animal by hundreds and even thousands.

Research into the cause of this disease by the former Bureau of Animal Industry has considerable historic importance. It was shown for the first time that an infectious disease could be transmitted by an intermediate host or carrier from one animal to another. This undoubtedly paved the way for the discovery that malaria and yellow fever are mosquito-borne diseases. This, in turn, made possible the building of the Panama Canal.

TREATMENT AND CONTROL--No successful treatment and no practical vaccine for widespread use were ever found. The most efficient approach was a Federal-State cooperative program to eradicate the fever tick, the only channel through which the disease was passed from animal to animal. Where fenced pastures could be spared, they were vacated from 6 to 13 months, depending on season, latitude, and other conditions, until the ticks were starved out for want of a host. Dipping, however, was found to be generally the more satisfactory method. After salt water, oils, greases, and sulphur had been tried, arsenical dips were found most effective and most readily tested under field conditions. Satisfactory proprietary dips soon became available on the market. Suspensions of the wettable powders of benzene hexachloride (BHC) and lindane are now recommended by the Department of Agriculture, if used with proper care; the emulsifiable concentrates are not recommended. Dipping of all cattle at 14-day intervals from March to November resulted in eradicating the tick. The northern quarantine line was held and gradually pushed south. By 1949, the quarantine zone had been reduced to less than 1 percent of its original area, and the South had been opened for widespread herd improvement. Today, the slender buffer zone along the lower Rio Grande averages less than 4 miles wide.

FEDERAL AND STATE RESPONSIBILITIES--The Department's program for eradication of the fever tick was carried out on a cooperative basis, each State concerned taking an active part. The border buffer zone of today is manned largely by cooperating Federal agencies, who can call upon the Texas Rangers and Texas sanitary officials as needed.

PUBLIC HEALTH ASPECTS--No cases of tick fever in human beings have been reported.

PUBLIC RELATIONS ASPECTS--The danger from tick fever is not over and will not be over so long as it is possible for cattle carrying the fever tick to enter the United States, either in normal commerce or by smuggling. Information channels, particularly in the cattle-grazing and cattle-feeding areas of the country, would do well to retell upon occasion the story of the constant job of protection being done along the border and the potential danger of tick fever entering the country and spreading, to the great detriment of the cattle industry.

FOR FURTHER INFORMATION--The U. S. Department of Agriculture has issued two Farmers' Bulletins, 1625, Tick Fever, (out of print; to be revised), and 1057, Cattle-Fever Ticks and Methods of Eradication (out of print). Men working on the tick quarantine along the border and those who took part in the eradication campaign are sources of colorful stories on this subject. The Threat of the Cattle-Fever Tick, a 16-mm. sound and color film, 16 minutes, was released by the Department in 1954.

TUBERCULOSIS

CAUSE--Tuberculosis is caused by a rod-shaped bacillus, Mycobacterium tuberculosis, of which three types are known--human, bovine, and avian.

AFFECTS mainly cattle, hogs, poultry, and man. Bovine tuberculosis may be transmitted to hogs and to man. Avian tuberculosis may affect all species of birds but is most common among domestic fowl; it also affects hogs and can infect cattle, but is rarely transmitted to man. Rats and mice may contract avian tuberculosis and spread the disease. Human tuberculosis can infect hogs, cattle, and dogs.

INCIDENCE--Tuberculosis is found in most parts of the world, and, in spite of a large-scale U. S. program to eradicate bovine tuberculosis since 1917, it still exists to some extent in every State and Territory. The avian form of the disease, which affects birds, hogs, and sometimes cattle, is a serious problem, especially in the Midwestern States.

SPREAD--Bovine tuberculosis may be spread to calves, hogs, and human beings through unpasteurized milk from infected animals. Cattle infect each other when in close proximity, through the common watering place, through body discharges, etc. Hogs contract one type or the other when they follow tuberculous cattle and root through their manure, when they consume the infected sputum of human beings, when they eat uncooked garbage containing the organisms, and by contact with infected poultry. Fowls propagate the disease largely through their droppings, which infect the ground, the floors of poultry houses, and feeding and drinking vessels.

THE DISEASE--Tuberculosis is an insidious disease, seldom becoming manifest until it has reached an advanced stage. The symptoms are not often definite in farm animals and poultry. The disease may become quite generalized throughout the body before external symptoms of general unthriftiness begin to appear. Some diseased hogs seem to be in prime condition, showing no indication of infection until they are slaughtered.

Animals afflicted with tuberculosis may show the effects of the disease in almost any part of the body. In its early stages, the disease is difficult to find, even in post-mortem examination, but in the later stages the nodules or lumps are very evident in the lungs, abdominal organs, and lymph glands, and attached to the walls of the abdominal and thoracic cavities. Lesions may also be found in the skin and in or on the bones. Gradual development of the disease in fowls begins to cause death in the poultry flock usually at ages 2 to 5 years.

Best diagnosis of tuberculosis is through the tuberculin test. Tuberculin is a sterile laboratory product made by growing the germs, mixing them with the substance on which they have grown, and properly diluting and preserving the mixture. When injected into animals affected with

tuberculosis, it causes a characteristic reaction at the point of injection. If used by a veterinarian it is a reliable agent for detecting tuberculosis in animals.

TREATMENT AND CONTROL--The only effective way to handle the disease is to eradicate it. A Federal-State program aimed toward this end has been in operation since 1917. Tuberculin-testing of all bovines is the first step. Animals reacting to the test are removed from the herd and slaughtered, Federal and State Governments sharing in the payment of indemnities. The premises are cleaned and disinfected. The herd is retested in 60 to 90 days, and any additional reactors are removed. When a county or other area shows less than one-half of 1 percent of reactors, it is declared to be a modified accredited tuberculosis-free area. The last county in the United States was so declared in 1940. The average number of reactors found as a result of testing was reduced from 4.9 percent in 1918 to 0.11 percent in 1952, 1953, and 1954 (it was up to 0.12 in 1955). Bovine tuberculosis has been brought under control but has not yet been eradicated. The number of reactors slaughtered following tests has dropped from 367,000 in 1935 to 10,304 in 1952, the lowest year; since then it has increased slightly.

Avian tuberculosis, which spreads among poultry and from fowls to swine, is still a problem, particularly in the Central and North Central States. Because the disease develops slowly in all species, poultry owners are urged to dispose of birds after the first laying year. This is an economical practice, in any event, because the egg yield decreases after the first year of laying. Diseased flocks should be eradicated entirely and the premises thoroughly cleaned and disinfected before restocking with new birds. In comparatively rare instances, involving valuable breeding stock, infected birds may be found and eliminated by use of the tuberculin test. Hogs and poultry should be kept separate, to prevent the avian type from passing to hogs.

FEDERAL AND STATE RESPONSIBILITIES--Federal and State Governments participate in the payment of indemnities for cattle slaughtered after reacting to the tuberculin test. To receive such payments, the owner must dispose of his diseased animals for slaughter within 15 days after the date of appraisal, and must then clean and disinfect his premises under official supervision. Nearly all States have passed legislation making herd-testing compulsory. The U. S. Public Health Service has sponsored legislation and regulations preventing the sale of dairy products except from tuberculosis-free herds. The Federal Meat Inspection Service reports cases of tuberculosis found in animals at slaughtering establishments and assists in tracing the diseased animals to the herds from which they originated.

PUBLIC HEALTH ASPECTS--Bovine tuberculosis in human beings has declined 85 percent since the eradication program began in 1917. One notable result has been the practical elimination of bone involvements in children caused by the bovine type of the disease. An improvement from the standpoint of food supply has been the great saving in meat. Before 1917, when the Nation had some 71 million cattle, nearly 50,000 beef carcasses were being condemned each year as unfit for human consumption because of tuberculosis. In 1954, when the country had more than 90 million cattle, less than 500 carcasses were condemned for this reason. This saving in meat has been important in relation to the increase of human population.

Tuberculosis remains a human health problem as well as a problem for the livestock industry. Until all types of this disease are wiped out, the disease will still be a menace to people of the United States, as it is for millions elsewhere in the world.

PUBLIC RELATIONS ASPECTS--Since the last county in the United States was accredited as a modified tuberculosis-free area in 1940, there has been a letdown in some areas in the campaign against tuberculosis. All media for the dissemination of information can assist in a drive for final eradication of the disease, for these reasons:

1. Whereas at the beginning of the program it was necessary to test about 25 cattle to find a reactor, the work grows harder as eradication progresses--it is now necessary to test 1,000 cattle on the average before finding an animal with the disease.

2. Officials applying tests tend to let down because of the remote chance they have of finding the disease.

3. Livestock owners participate in the prevailing complacency. They need to be reeducated to the important role they have in eradicating the disease.

4. Inability to trace back to the herd of origin all animals found infected at the time of slaughter has retarded eradication. A system of marking cattle--and "keeping book" on the eartags--has been launched by animal disease eradication officials of ARS, cooperating with dairy herd improvement associations and artificial breeding services. This should make tracing of tubercular cattle an easier matter than in the past.

5. There is reason to believe that cattle are becoming more susceptible to the disease because they have been out of contact with it. Potentially, the situation is more explosive than when the disease was more common--a little infection can go a long way.

Press, radio, and television materials pointing up these problems can greatly assist in the eradication campaign.

FOR FURTHER INFORMATION--State livestock sanitary officials and the Federal veterinarian in charge in each State can provide current local information on this disease. The Agricultural Research Service, U. S. Department of Agriculture, Washington 25, D. C., issues annual statistics, on a fiscal-year basis, on tuberculosis eradication. Livestock Conservation, Inc., 405 Exchange Bldg., Union Stockyards, Chicago 9, Ill., publishes timely literature on this subject. Public health authorities, in Washington, D. C., and in the State or area, can provide information on the human health aspects.

The U. S. Department of Agriculture has issued three Farmers' Bulletins on this subject: Tuberculosis of Fowls, 1200; Tuberculosis of Hogs, 781; and Tuberculosis in Livestock, 1069 (all three out of print). The Department's color-and-sound film on avian tuberculosis, Vicious Circle (16-mm., 20 minutes), was released in 1954.

VESICULAR EXANTHEMA (VE)

CAUSE--Vesicular exanthema is caused by a filtrable virus. There are four known types of the virus--A48, B51, C52, and D53, numbered for the years of discovery--and there is a possibility of three other types.

AFFECTS only hogs.

INCIDENCE--VE has been identified only in the United States. It has been present in California since 1932, where it was first thought to be foot-and-mouth disease. Dr. Jacob L. Traum of the University of California established the fact that it is a different disease. Beginning in June 1952, VE first appeared outside California and has spread widely, invading 41 other States and the District of Columbia, though it has not existed in more than 22 States at any one time. An eradication campaign is being waged against the disease. Its occurrence by the end of 1955 had been reduced to 29 counties in 4 States.

SPREAD--The vesicular exanthema virus penetrates to every part of the body of an infected animal. The disease is most commonly disseminated when infected raw meat scraps are fed to hogs in uncooked garbage. In California, the disease was 1,000 times more prevalent in garbage-feeding establishments than in grain-feeding establishments. It can also be spread from animal to animal, by infected pens, premises, and livestock carriers, and by contaminated footwear and clothing.

THE DISEASE--Vesicular exanthema is an acute, febrile, infectious disease of swine, characterized by the formation of vesicles or blisters on the feet and snout, and on the teats and udder of nursing sows. At the onset of the disease, the temperature rises to 105° to 107° F. Vesicles form during this febrile stage, and the animal shows great lassitude and lack of appetite. The vesicles rupture in 24 to 48 hours, leaving a raw eroded surface, and the temperature drops rapidly. The lesions heal quickly, but those in the feet particularly may invite the entry of secondary infections. There may be another rise in temperature and the appearance of secondary lesions, but these do not occur in all cases. Hogs lose 5 to 10 percent of their body weight during the acute stage of the disease. The mortality rate in adult hogs is quite low, but it runs higher in suckling pigs. From 3 to 90 percent of a herd may show lesions of VE, but many without observable lesions are actually infected. Raisers of garbage-fed swine claim that the chief loss from infected animals is an additional 30 days of feeding for the market.

TREATMENT AND CONTROL--There is no known cure for this disease, and no effective vaccine. For the following reasons, therefore, eradication is the accepted practice: The disease causes considerable economic losses to producers and has drastic effects on markets and commerce. If

permitted to become established, it might, like other virus diseases, now and then become excessively virulent and cause great damage and loss to the swine industry. And, since VE cannot be distinguished visually from foot-and-mouth disease, it might at any time mask the presence of this disease.

Laboratory tests and animal inoculations are used to differentiate this from the other vesicular diseases--foot-and-mouth and vesicular stomatitis. Eradication measures include: Quarantine, slaughter of infected and exposed swine, special processing of animals that show no evidence of the disease, and disinfection of contaminated premises and facilities before restocking.

FEDERAL AND STATE RESPONSIBILITIES--The Secretary of Agriculture on August 1, 1952, declared a state of emergency, which made it possible for the Department of Agriculture to enter into a cooperative eradication campaign in the affected States, in most cases including the payment of indemnities, half with Federal and half with State funds. Quite early in the campaign, raw garbage fed to hogs was recognized as the commonest carrier of the disease, and many States began to pass legislation and issue regulations that garbage fed to hogs must be cooked. By the end of 1955 all but two States had such laws or regulations in effect. Emphasis in most States was then placed on frequent inspection and enforcement of laws and regulations. Generally, State laws require that garbage feeders must be licensed. Their premises must be inspected to see that garbage is boiled for 30 minutes before it is fed to hogs and that feeding is carried out under sanitary conditions.

Federal regulations limit the movement of garbage-fed hogs in interstate commerce and require the washing, cleaning, and disinfection of certain carriers and facilities used by swine that are moved in interstate commerce. State laws and regulations in many States impose the same or similar restrictions on animals and carriers moving intrastate.

PUBLIC HEALTH ASPECTS--None so far as vesicular exanthema is concerned, since the disease is not known to affect human beings. However, the garbage-cooking program also kills other organisms, including the Trichinella parasite which, when consumed by people in undercooked pork, causes trichinosis, a disease in humans.

PUBLIC RELATIONS ASPECTS--Since raw garbage can also spread other diseases, including tuberculosis, hog cholera, trichinosis, and foot-and-mouth disease, the garbage-cooking program has an importance above and beyond that of its effect on vesicular exanthema. A public service can be provided by follow-up stories on the inspection of swine, finding the disease on the premises and preventing its spread to concentration points, the licensing of garbage-feeding establishments, their inspection to see that the garbage is cooked properly and that the cooked garbage is fed under sanitary conditions.

FOR FURTHER INFORMATION--The Agricultural Research Service can provide abundant information from a national point of view. A 16 mm., color-sound motion picture, Vesicular Exanthema, running 16 minutes, was released in 1954.

Some State Extension Services provide program information on VE. For news of local outbreaks, licensing, inspection, and enforcement, State livestock sanitary officials are the best source.

VESICULAR STOMATITIS (VS)

CAUSE--Vesicular stomatitis is caused by a filtrable virus, said by British investigators to measure 70 to 100 millionths of a millimeter. The former Bureau of Animal Industry discovered in 1925 that there are two types of the virus, which were named Indiana and New Jersey. An animal recovering from one type of the disease is immune for a time to that type but is susceptible to the other.

AFFECTS cattle, horses, mules, and occasionally hogs. A previous conception that the disease did not affect hogs was upset in 1952-53, when there were several natural outbreaks among these animals.

INCIDENCE--Vesicular stomatitis is known in Europe and South Africa, has occurred sporadically in the United States, and is quite common in Mexico and parts of South America. Curiously, the first known outbreak in the United States was discovered in France during World War I, when infected Army horses were sent overseas.

SPREAD--The disease appears to spread for the most part by direct contact with recently affected animals or by contact with recently infected feed boxes, water troughs, bridles, pails, or other objects contaminated by discharges from the infected animal's mouth.

THE DISEASE--Vesicular stomatitis is a febrile disease characterized by the formation of vesicles or blisters in the mouth, and, in cattle and swine, between the toes and on the teats. The disease is visually indistinguishable from foot-and-mouth disease, and tests must be made to differentiate between them. The animal is usually depressed at the onset of the disease and runs a temperature of 105° to 107° F. Vesicles appear in the mouth and there is a flow of stringy or frothy saliva. The painful condition of the mouth at this stage causes the animal to refuse food. The vesicles break, leaving a raw eroded surface on the tongue and mouth surfaces, the temperature subsides, and the animal begins to eat rather quickly.

Unlike foot-and-mouth disease, vesicular stomatitis rarely affects calves. But, in order to be certain about the ailment, differential diagnosis is required, as in vesicular exanthema and foot-and-mouth disease. There are seldom any losses in uncomplicated cases of vesicular stomatitis, and complications are rare. In hogs, however, the disease may be nearly as serious as vesicular exanthema.

TREATMENT AND CONTROL--The animals are usually given local treatment; most of them recover spontaneously in a few days.

FEDERAL AND STATE RESPONSIBILITIES--Because of the importance of differential diagnosis, the Department of Agriculture has had an active

research project on this disease in recent years. A laboratory serological typing test has been developed and is used to confirm field diagnosis and to type field strains of the virus.

In any outbreak of a vesicular disease, a special diagnostician is called in to make a differential diagnosis by animal inoculations. After a positive diagnosis of vesicular stomatitis, the diagnostician and other State or Federal veterianarians check with farmers and local veterinarians to see if there is any evidence of spread. This attention is continued periodically until the vesicular condition has disappeared.

PUBLIC HEALTH ASPECTS--Human beings are susceptible to infection with the virus of vesicular stomatitis, but the disease is usually contracted only by diagnosticians, laboratory workers, and others who are closely associated with infected animals or with the virus. The disease does not cause vesicles in man. Symptoms are those of a cold or influenza; there is a fever for 1 to 7 days. Recovery is rapid and is followed by immunity.

PUBLIC RELATIONS ASPECTS--Vesicular stomatitis per se raises no issue of public relations. Premature announcement before diagnosis may create a hysteria reaction based on the belief that the outbreak is foot-and-mouth disease. Those in charge of information channels should await diagnosis before making any announcement.

FOR FURTHER INFORMATION--Because VS so far has had very little economic importance, not much has been published on the disease in recent years. The Department of Agriculture has a mimeographed statement, Vesicular Stomatitis of Horses and Cattle. It also has a motion picture, Vesicular Diseases of Animals (16 mm., 11 minutes, color, sound, revised 1951).

Information on local occurrence of the disease may be obtained from the Federal veterinarian in charge in any State or from the State veterinarian.

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